TECHNOLOGY DEPT.

JULY 1951

FOUNDRY

WHEREVER METALS ARE CAST

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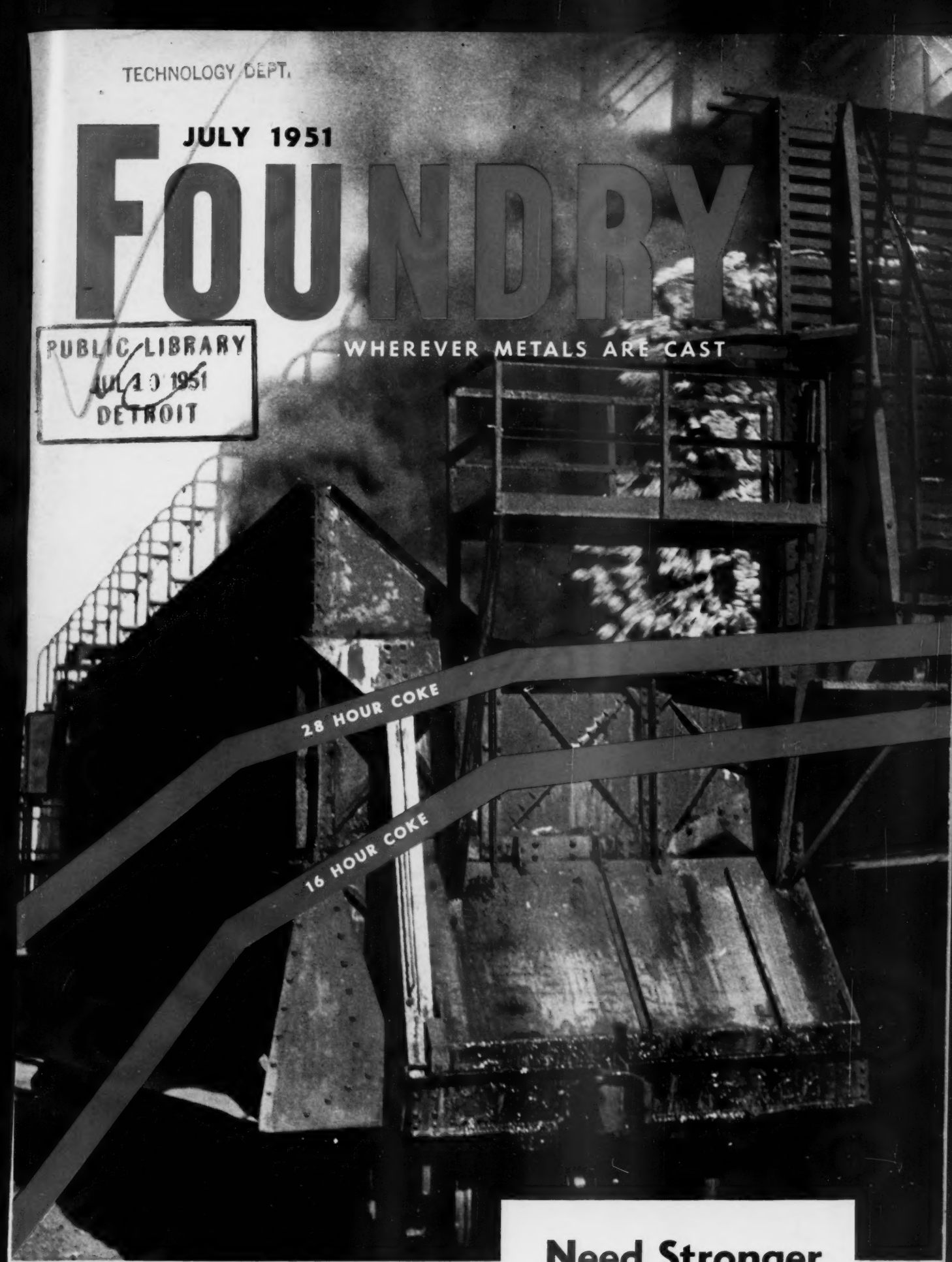


Need Stronger Foundry Coke

—see page 72

R v. 29?

July-Dec. 1951

get CLEANER... SOUNDER... BETTER IRON CASTINGS with PURITE

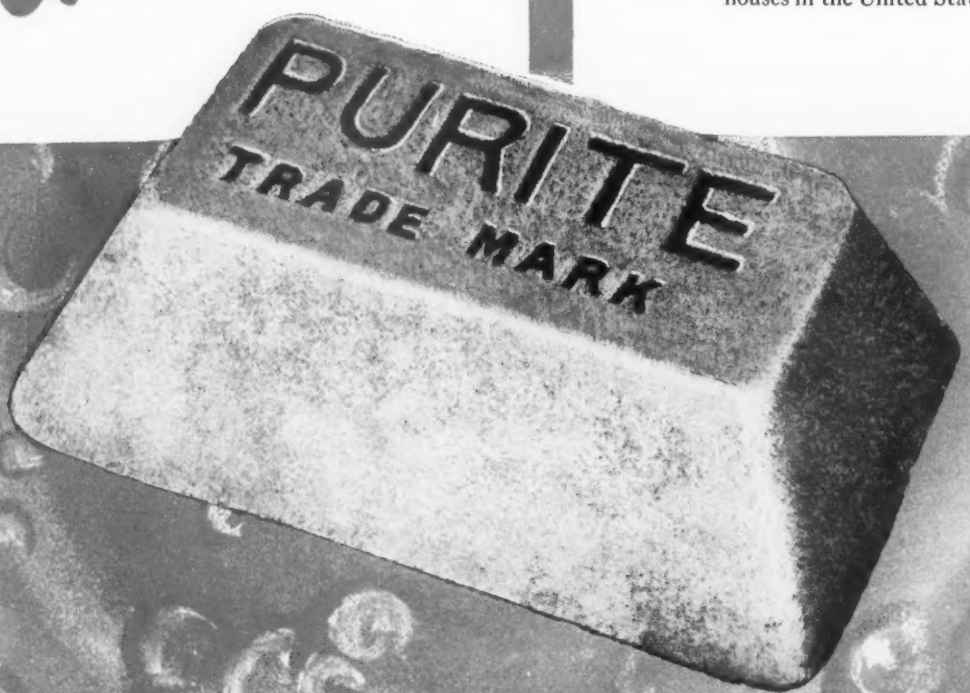
Progressive foundries throughout the country have standardized on Purite as their desulphurizer and cupola flux for improved iron castings. And their reasons for this practice are seven-fold.

1. **Purite gives 100% fluxing action in the cupola — 100% desulphurizing action in the ladle.**
2. **Purite gets to the iron faster — no quicker desulphurizer made.**
3. **Purite is time-tested and proven for unsurpassed desulphurizing uniformity.**
4. **Purite comes in 2-lb. pigs — no weighing or measuring required.**
5. **Purite is 100% pure fused soda ash — you do not pay for inert materials.**
6. **Purite does not crumble — no waste — no dust.**
7. **Purite can be shipped in bulk carloads at substantial savings over bag shipments — is easily stored without deterioration.**

These benefits prove why Purite enjoys such widespread acceptance among iron foundries as the foremost cupola flux and desulphurizing agent. Write today for full information on how the quality of your iron castings can be improved with Purite. Mathieson Chemical Corporation, Mathieson Building, Baltimore 3, Md.

PURITE 100% fused soda ash. The Scientific Flux for Better Melting and Cleaner Iron.

PURITE is sold by all leading foundry supply houses in the United States and Canada.



Mathieson
CHEMICALS

Tech

SERVING INDUSTRY, AGRICULTURE AND PUBLIC HEALTH

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INTRICATE LARGE CASTINGS ...readily produced in DUCTILE IRON

STAVER FOUNDRY COMPANY, Virginia, Minn., produced this large hoist drum in ductile iron to meet requirements of toughness with strength, and wear resistance with good machinability.

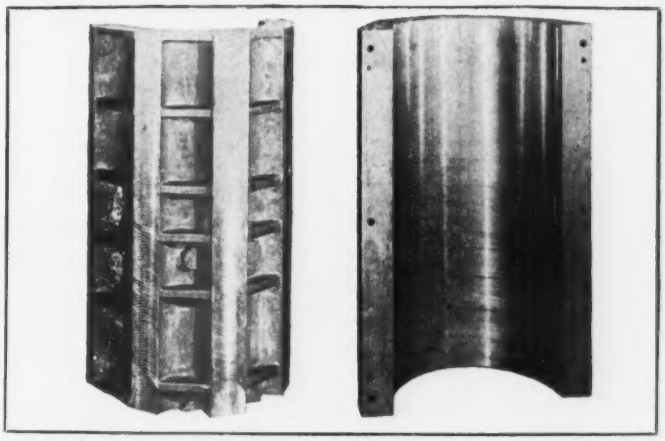
DUCTILE IRON is a cast ferrous product that combines the *process advantages* of cast iron with many of the *product advantages* of cast steel.

In less than two years, ductile iron has attained wide acceptance because it offers excellent castability, high mechanical properties, and good machinability. Parts cast in ductile iron show superior pressure tightness, high modulus and resistance to shock.

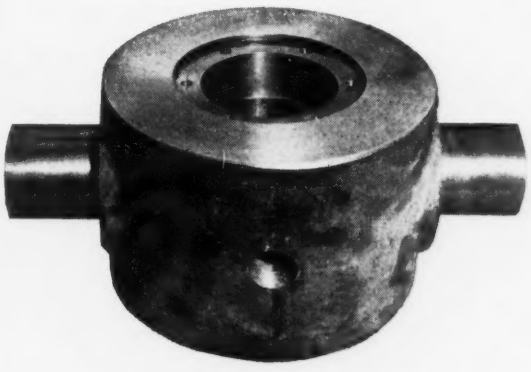
Typical current applications include chemical pots, compressor shells, cylinders for hydraulic presses, fly wheels, housing for electric power driven tools, large gears for coal mine equipment, vise jaws, and many other parts.

AVAILABILITY

Send us details of your prospective uses, so that we may suggest a source of supply from some 100 authorized foundries now producing ductile iron under patent licenses. Request a list of available publications on ductile iron...mail the coupon now.



PYOTT FOUNDRY & MACHINE CO., Chicago 7, Ill., produced these ductile iron castings for dies for forming 24" to 36" diameter pipe from steel plate of ¼" to ½" thicknesses. The finished tooling was done by the Vernon Allsteel Press Co. of Chicago. The dies are to be used in large presses that exert 18,000 tons pressure.



ST. PAUL FOUNDRY & MANUFACTURING CO., St. Paul 3, Minn., cast this hydraulic head for a billet conditioner in ductile iron having 92,000 p.s.i. tensile strength, 67,000 p.s.i. yield point and 7.8% elongation.

EMBLEM OF INCO SERVICE

The International Nickel Company, Inc.
Dept. F., 67 Wall Street, New York 5, N. Y.

Please send me a list of publications on: **DUCTILE IRON**

Name.....Title.....

Company.....

Address.....

City.....State.....

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.

. . made from quick-flash coal!

FIGURES FROM BUREAU OF MINES, DEPT. OF INTERIOR OF THE U. S.
(Moisture Free)

PROXIMATE ANALYSIS

Volatile Matter	38.9%
Fixed Carbon	57.4%
Ash	3.7%
	100.0%

ULTIMATE ANALYSIS

Hydrogen	5.4%
Carbon	82.0%
Nitrogen	1.6%
Oxygen	6.6%
Sulphur	.7%
Ash	3.7%
	100.0%

Fusion Point of Ash 2980° F

CROWN HILL SEACOAL FACING

CROWN HILL excels as a facing material because it is made from top quality, quick-flash coal . . . carefully pulverized and graded to match sand grain size, for maximum effectiveness. Foundrymen everywhere prefer CROWN HILL because its quick combustibility induces faster escape of gas and steam . . . produces a better finish . . . slashes cleaning costs. Your foundry, too, can use CROWN HILL to good advantage. Why not order a supply today?

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JULY 1951

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LINOIL

The tailor-made, all-purpose core oil – available in various grades to meet any core room situation. More than a half million gallons of Linoil are used monthly by foundries all over the United States and in Canada. Linoil has been known for uniform quality for over 30 years... is accepted as a standard in the industry by the nation's leading foundrymen.

INDUCTOL

The newcomer in core oils – developed in ADM's Research Laboratory principally to increase core baking efficiency through faster baking and resistance to overbaking. Foundries using Inductol report up to 50% increase in oven capacity. Inductol has excellent collapsibility – burns away rapidly at temperatures above 800°F. – a particularly desirable characteristic in magnesium, aluminum and malleable iron casting.

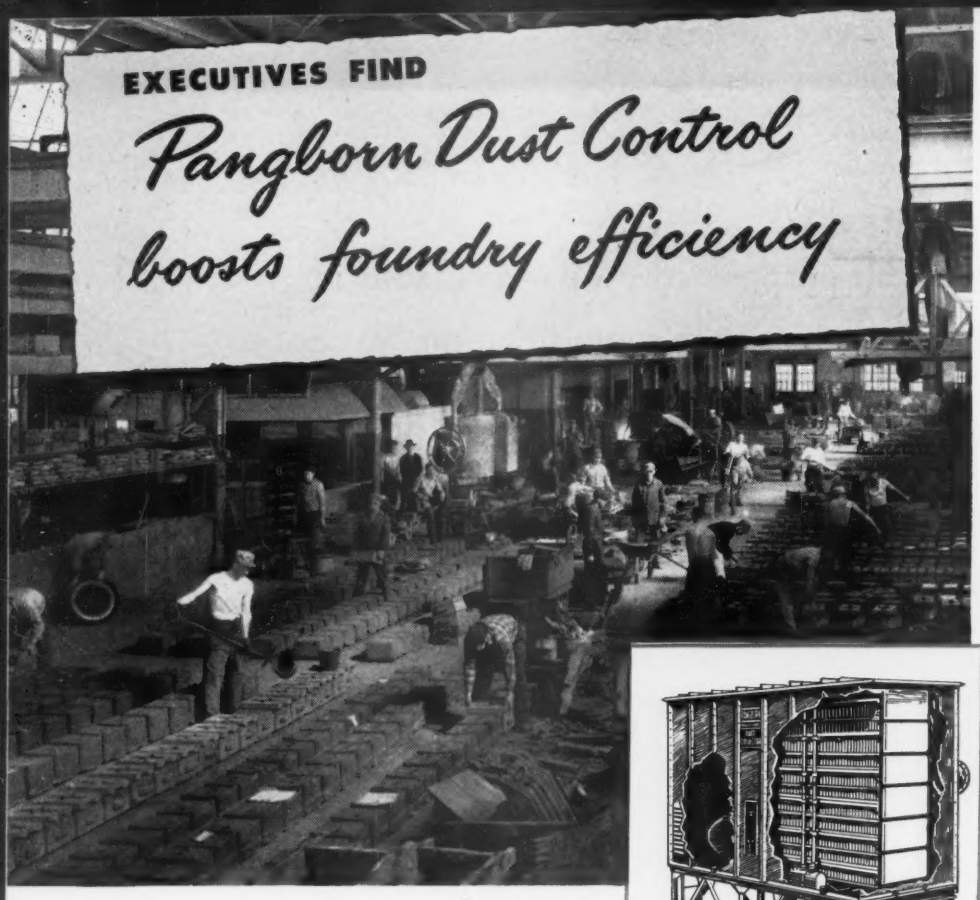
LINOIL-INDUCTOL COMBINATIONS PAY OFF

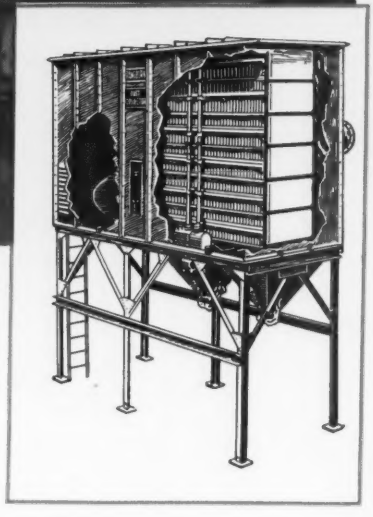
Many foundries benefit by using both Linoil and Inductol... Linoil, for general, all purpose core room use—Inductol, where faster baking is required or greater oven capacity is needed.

Call on your Linoil man for advice. If you have a core room problem, use ADM's Research Laboratory—it's a *Free Service.*

EXECUTIVES FIND

Pangborn Dust Control boosts foundry efficiency





Cutaway view of Pangborn "CH" Collector ➤

TAKE the dust out of a foundry and efficiency goes up! That's the experience of scores of executives . . . who protect their investment in equipment and manpower with Pangborn Dust Control.

Take the experience of the Penn Steel Castings Co., Chester, Pa. Their Pangborn "CH" Dust Collector is mounted directly outside the cleaning room. Its primary job is to protect the blast cleaning equipment from excess abrasive dust.

But equally important is the *dust-free working area.* Skilled workers are easier to get and to hold when bothersome dust is eliminated. In addition walls and windows stay cleaner longer and general maintenance costs average much less.

Don't let dust rob you of profits . . . find out about Pangborn Dust Control. Bulletin 909A gives the complete story. For your copy write to:

PANGBORN CORPORATION,
1400 Pangborn Blvd., Hagerstown, Md.

Pangborn

DUST CONTROL

STOPS THE DUST HOG from stealing profits

ADVERTISEMENT

If you haven't heard it . . .

IT'S NEWS!

Never put off until tomorrow what you can do today—especially in these times: it will probably cost 15% more tomorrow.

* * *

Speaking of inflation, things are getting so bad that businessmen are having to pay their five-percenters 7½%.

* * *

Remember when men used to lose their shirts in the market? Nowadays with inflation, the high price of food and all, you can lose it in the supermarket.

* * *

Propaganda is telling your wife how nice she looks in her old dress when you think she is about ready to want a new one.

* * *

One of the best rules for getting ahead (if you want to get ahead): don't sit around waiting for your ship to come in—row out to meet it.

* * *

If you are in the foundry business, one of the best ways to row out to meet that ship is to cast a critical eye at your cleaning room. Honestly now, are you trying to produce 1951 model castings with a model T cleaning set-up? If so, you are waiting for the ship. Modern Pangborn blast machines can help you produce better castings faster and at lower cost. Drop us a line today.

* * *

Then there was the hillbilly who said he didn't use toothpaste because none of his teeth were loose.

* * *

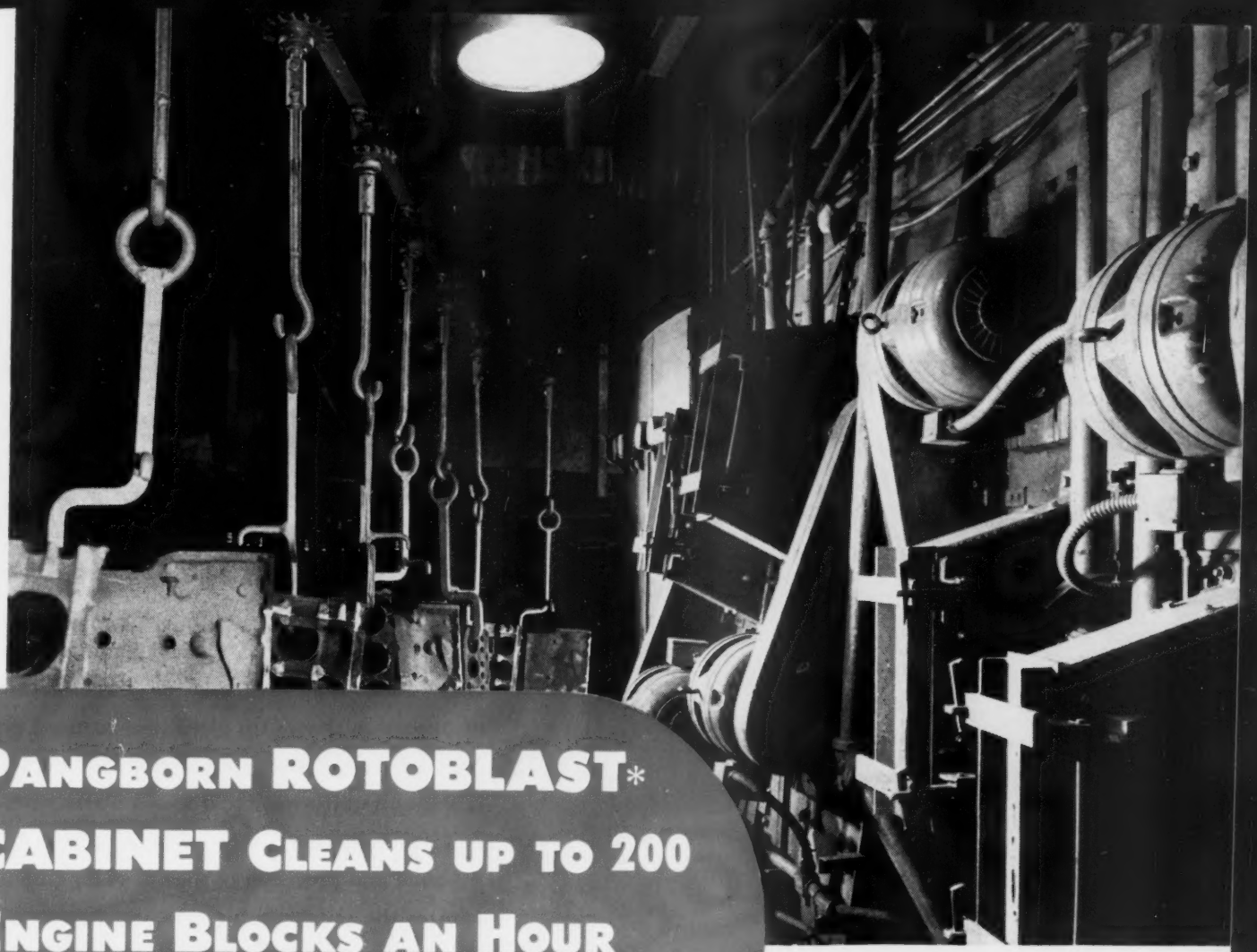
A conference is a meeting at which people sit around talking about things they should be doing.

* * *

There ought to be a law against disseminating information of this kind (and there probably is) but the killjoy statisticians now tell us that for equipment and transportation, American sportsmen spend about $60 a pound for their fish and game.

* * *

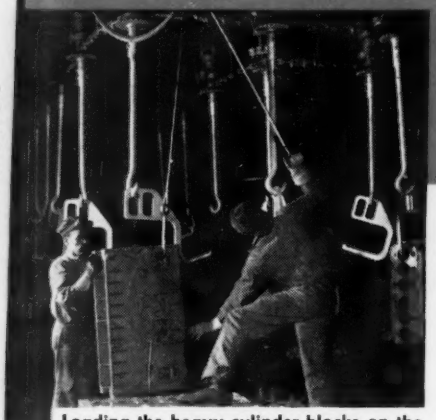
The trouble with most of the sound advice you get these days is that it is mostly sound and mighty little advice.



PANGBORN ROTOBLAST* CABINET CLEANS UP TO 200 ENGINE BLOCKS AN HOUR

at world's largest independent jobbing foundry

ABOVE: This rear view of Campbell, Wyant, Cannon's Pangborn "ES" ROTOBLAST Cabinet shows the conveyor system and four ROTOBLAST Machines. Inside the cabinet, the conveyor stops in front of each ROTOBLAST unit and slowly revolves the casting in the blast stream to assure complete cleaning.



Loading the heavy cylinder blocks on the conveyor is easily handled by two men.

BLAST CLEANING at Campbell, Wyant, Cannon Foundry Co., of Muskegon, Mich., is fast, efficient and *mechanized!* And the secret of this performance is two Pangborn "ES" ROTOBLAST Cabinets like that shown above. Heavy engine blocks can be cleaned at a rate of *200 an hour* . . . and cleaning is automatic! The result is faster, better, cheaper blast cleaning than ever experienced with other equipment.

Campbell, Wyant, Cannon started to mechanize their cleaning operation in 1937 . . . when they installed one of the first Pangborn monorail ROTOBLAST Cabinets. Later they installed a second Cabinet to meet production demands. As a result cleaning costs have been even further reduced, and there's no cleaning room bottleneck. Cleaning is a simple, automatic operation with high-quality work assured.

GET THE COMPLETE ROTOBLAST STORY: Bulletin 214 is informative and covers many applications. Write for your free copy to: Pangborn Corporation, 1400 Pangborn Blvd., Hagerstown, Md.

ROTOBLAST . . .

SAVES LABOR with push-button operation

SAVES SPACE because machines are compact

SAVES TIME by cleaning more loads per day

SAVES POWER since no compressor is needed

SAVES TOOLS because all scale is removed

MEMBER FEMA

Look to Pangborn for the latest developments in Blast Cleaning and Dust Control equipment.

Pangborn

BLAST CLEANS CHEAPER

with the right equipment for every job

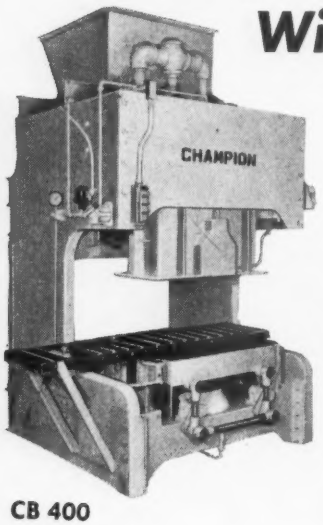
You're Sure to Win

Which Means Most to You:

Quality, Quantity, or Low Operating Costs?

With a Champion Core Blower,

You Get All Three!



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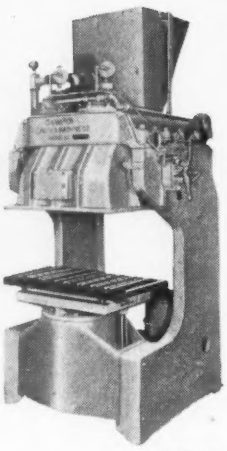

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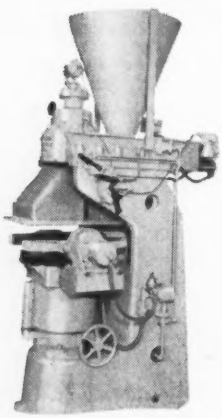

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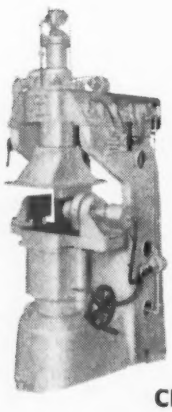

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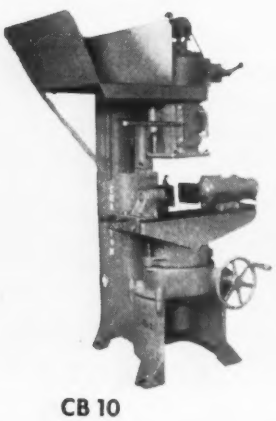
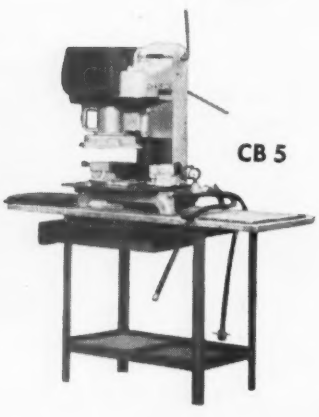


CB 10



CB 5

And you don't have to figure Champion savings only on the "long run" basis. Day to day economy of operation shows up clearly in reduced power costs, easier operation that eliminates fatigue, precision and uniformity that avoid waste.

The long term economies are there, too. Stamina and precision built into every Champion insures the same trouble-free, quick, easy operation over the years, without costly down-time or maintenance.

When a Champion Core Blower is installed in a foundry, that is the beginning—not the end—of our interest in it, which continues as long as it is in service.

HOW FREE IS AIR?

Any foundry superintendent knows it costs money to keep an air line filled, and the higher the pressure, the more it costs.

Champion Core Blowers and Molding Machines, among their various excellent features, operate on pressures as low as 85 lbs. with great ease and full efficiency. *Excessive Pressures are the Principal Cause of Core Box Wear and High Machine Maintenance. Where Exceedingly High Pressures are Carried in the Line, Regulators are Recommended.*

Plants equipped entirely with Champion machines, enjoy a substantial saving in general operating costs, at no sacrifice in productive efficiency.

...with Champions!

...eport from Another Satisfied User

(The Champion roll-call is world-wide.)

Original and translation of letter ...ecently written by the builders of ...Lancia Automobiles, Turin, Italy:

LANCIA & C. FABBRICA AUTOMOBILI - TORINO - S.A.

CAPITALE SOCIALE L. 50.000.000 INTERAMENTE VERSATO

Spett. Ditta
Fratelli MUSSO
Corso Bramante 56
TORINO

22 Febbraio 1951.

N/ riferimento TEPRO/2248

Oggetto: Macchine "CHAMPION".

Riferendoci alla pregiata Vs/ del 6 Febbraio 1951 ... abbiamo il piacere di comunicarVi che le ... CHAMPION installate presso la ... hanno dato ottimi ...

Gentlemen:

With reference to your letter of February 6, 1951, we are pleased in informing you that the Champion Core Blowers installed in our Bolzano Foundry are giving very satisfactory results, both from the operating and output points of view.

We shall therefore be pleased if you will convey to the manufacturers our most sincere satisfaction.

As requested by Messrs. Champion Foundry & Machine Company, we send you herewith two photographs illustrating the Champion Core Blowers operating in our foundry.

We hope this is to your satisfaction, and meanwhile remain,

Yours very truly,
LANCIA & CO.
Technical Production Department
s/ Armando Pilotti.

Champion CB 15 Core Blower in Lancia foundry.

Champion CB 10 Core Blower in Lancia foundry.

Champion
FOUNDRY AND MACHINE COMPANY

...OFFICE, 1553 W. MADISON STREET, CHICAGO 7, ILL.
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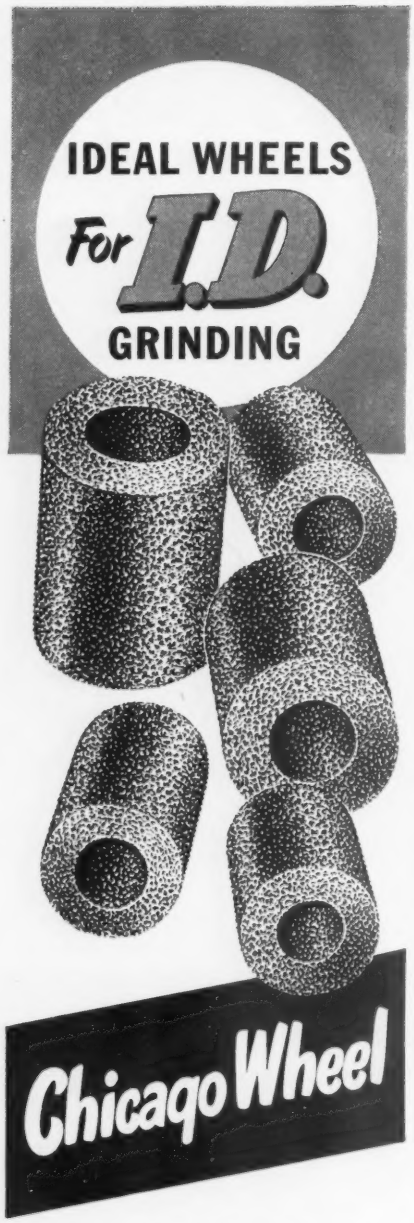


Internal Grinding Wheels

For internal grinding operations, you just can't beat Chicago Wheels. They give you better finishes faster . . . with no wobble, flutter, or chatter, and size perfectly. Today . . . with production demands soaring, they're your best buy, because they're "tailor made" to your own particular specifications . . . ideally suited for every I.D. requirement.

Rapid Delivery

Chicago Wheel's speedy production facilities assure you perfectly balanced Internal Grinding Wheels *when you need them.* Write today for full information and sample wheel.

CHICAGO WHEEL & MFG. CO.
Dept. F • 1101 West Monroe Street
Chicago 7, Illinois

With the EDITORS

REMINISCING: Sitting in the Union Station in Washington the other night waiting for the Cleveland train, the editor could not help but recall the similarity of that scene with those enacted in the same station back in 1941 when we were getting ready for World War II. While the people are not the same, the men in uniform look very much as they did 10 short years ago. The movement of military personnel reminded the editor of the night back in 1941 when he stood in the same station and saw a large detachment of army personnel with complete equipment waiting for a train to New York. Talking with some of the boys confirmed the fact that they had an idea as to where they were heading, but they were not talking about it. One could see that they wished to tell that they were on their way to Iceland on an adventure that had great possibilities for success or failure. And the editor could not tell them he knew that they were going to establish the first outpost of the great American army in the Atlantic. Sitting in the station the other night we could not help but wonder where all these service boys are going and what the next year or so will bring.

—o—

Where-To-Buy: As a further service to readers, the Where-To-Buy section, covering a complete listing of products of FOUNDRY advertisers, will be published periodically as a separate section, starting with this issue. This directory section is of exceptional value to those individuals in the industry concerned with the specification and ordering of all types of foundry equipment and foundry supplies. A limited number of additional copies are available on request.

—o—

Aberdeen Proving Ground: Along with a good representation of editors belonging to the Society of Business Magazine Editors, Bill Gude and the editor spent June 7 at Aberdeen Proving Ground, Aberdeen, Md. Both were greatly impressed with the facilities which have been developed there for training enlisted men and officers, for testing all types of ordnance materiel, for conducting tests in the supersonic wind tunnel at speeds four times the speed of sound, and for testing ballistic properties, to name only a few. We were especially interested in the museum where we saw captured materiel as well as the developments of our own army. One thought struck us forcibly. If the nations of the world had been able to devote as much time, brains and money to the study of peacetime problems as they seem to have spent in the development and production of the implements of war, how much better mankind and the world would be.

—o—

Castings: And speaking of the museum, both editors were greatly impressed with the poor quality of castings on recently captured Soviet materiel as compared with the components produced by American foundries. While the German castings on captured World War II equipment were better than the Russian, they were not as good as our own. American foundrymen can take great pride in the quality of cast armor found on the new tanks which we saw under test at Aberdeen.

—o—

Penton's Foundry List: Business Manager George Pope tells us that the 1951-52 edition of Penton's Foundry List is progressing nicely and should be available for distribution some time in August. George has promised that we will have a statistical count of foundries in the United States and Canada for presentation in the August issue. These figures are most interesting, so be on the lookout for them.

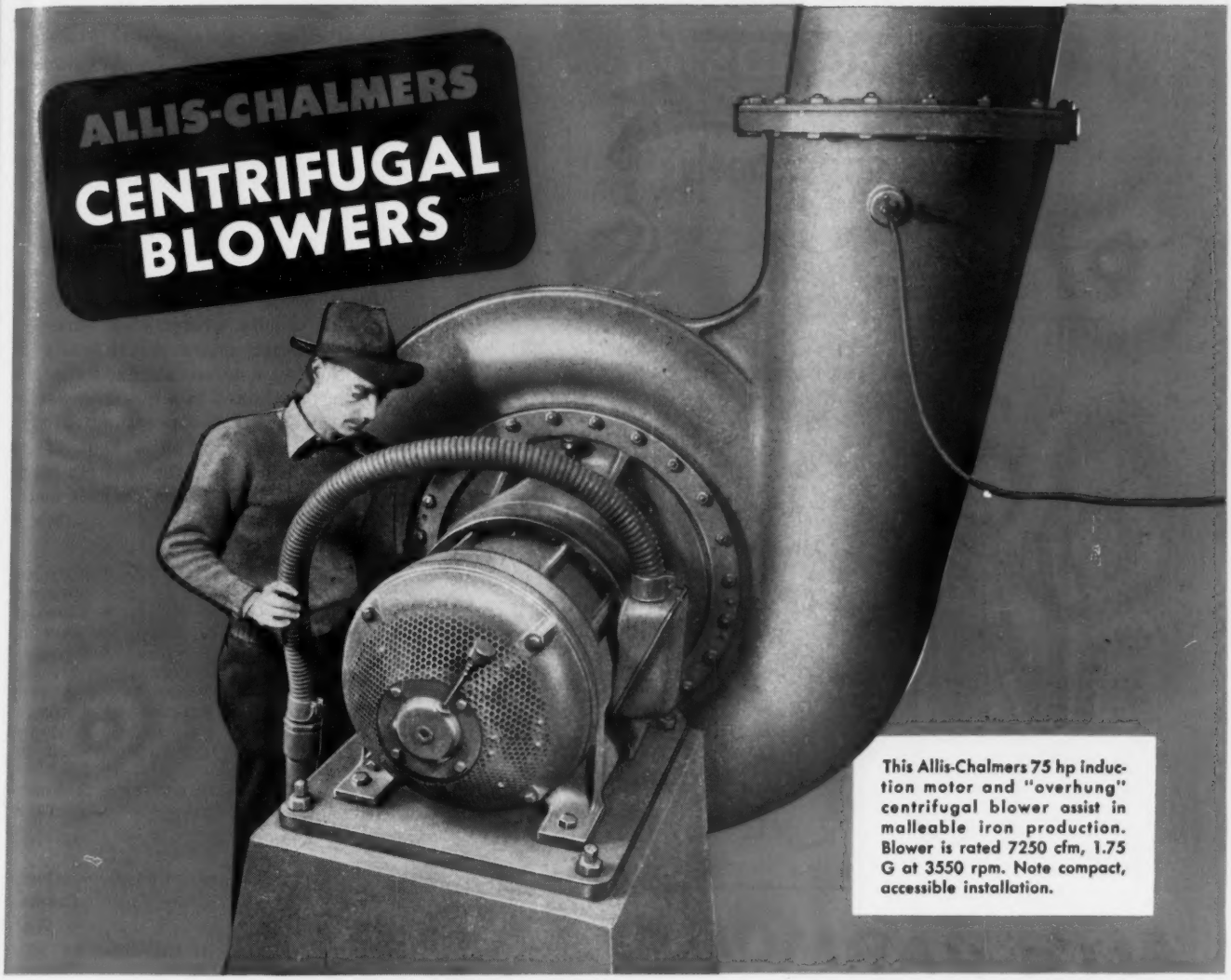
—o—

Impossible: Remember how some of the extroverts in World War II agencies bragged about their abilities with this motto: "The difficult we do immediately; the impossible will take a little longer." Now we understand that the boys in the defense agencies have coined a new motto: "If it is difficult, we will make it impossible." This is what might be called organized confusion.

—o—

Visitors from Holland: For many years foundrymen from abroad have made the office of FOUNDRY at Cleveland a port of call on their travels around this country. Needless to say, the editors have enjoyed these visits

(*Concluded on page* 12)



This Allis-Chalmers 75 hp induction motor and "overhung" centrifugal blower assist in malleable iron production. Blower is rated 7250 cfm, 1.75 G at 3550 rpm. Note compact, accessible installation.

Where Control is Vital!

RIGID QUALITY CONTROL is vital when you're making malleable iron. With component elements demanding precise control, cupola operation becomes especially critical.

The Allis-Chalmers centrifugal blower seen above performs this demanding duty 20 to 22 hours daily at the foundry of a large Midwestern malleable iron company.

The constant air weight control on the blower inlet *automatically* delivers more or less air, as required, without the necessity of blowing off to atmosphere and wasting power, as with positive pressure blowers. Connection below flange at upper right goes to discharge pressure gauge.

A metered amount of oxygen enters the cupola, giving a uniform temperature and greater uniformity in composition of the metal. *Wherever* a quality product is desired, consider Allis-Chalmers blowers with constant air weight control. You get these standard features:

- **Compact, close coupled design.**
- **Low noise level, long lived cast iron casing.**
- **Anti-friction bearings supporting the impeller, only moving part.**

For complete information call your nearest A-C sales office or write to Allis-Chalmers, Milwaukee 1, Wis. for Bulletin 16B6048A.

A-3430

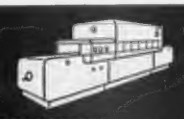
ALLIS-CHALMERS

Foundromatic and Regulex are Allis-Chalmers trademarks.

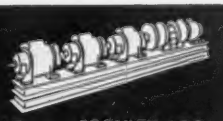
Foundry Equipment for Bigger Output-Better Working Conditions!

FOUNDROMATIC SHAKEOUTS

MOTORS-DRIVES-CONTROL


FOUNDROMATIC CORE DRYER

INDUCTION HEATING & MELTING


REGULEX ARC FURNACE CONTROL

SIMONDS
ABRASIVE CO.
grinding wheels

ALL'S HARMONY
in the grinding department

For better output, these boys know the score. It's Simonds Abrasive Company grinding wheels for the stepped-up tempo of defense requirements. Simonds complete line has everything to keep *your* production in tune with today's needs . . . grinding wheels for every operation, mounted wheels and points, segments and abrasive grain . . . top quality products backed by Simonds Abrasive Company's reputation as a major grinding wheel manufacturer for almost 60 years. Write for free grinding data book listing name of your Simonds distributor.

SIMONDS ABRASIVE COMPANY, PHILADELPHIA 37, PA. DISTRIBUTORS IN PRINCIPAL CITIES

Division of Simonds Saw and Steel Co., Fitchburg, Mass. Other Simonds Companies: Simonds Steel Mills, Lockport, N. Y., Simonds Canada Saw Co., Ltd., Montreal, Que. and Simonds Canada Abrasive Co., Ltd., Arvida, Que.

(*Concluded from page* 10)

greatly, since they have provided a greater insight into foundry operations in the various countries of the world. The most recent visitors were A. S. de Muinck Keizer, director, and G. A. Romer, chief engineer, Nederlandsche Staalfabricken, Utrecht, Holland, producer of steel castings.

—o—

Raised Eyebrow Department: A political writer on the *Cleveland Plain Dealer* usually presents an interesting quotation under this heading in his Sunday column. Perhaps the following, contained in a news release of the Economic Co-Operation Administration reporting on a visit of 17 representatives of the British nonferrous metals industry to this country, might be our "Raised Eyebrows Department."

"The American worker readily accepts new machines . . . He welcomes new methods and firmly believes in the profit motive, since in this he sees opportunity for increased wages.

"Trade union organization . . . in the majority of cases takes a very active part in supporting management functions, e.g., time study, job evaluation, rate fixing, promotion, incentives, methods, etc.

"However, organized labor in America is prepared to leave management to manage . . ."

—o—

Department of Congratulations: The May issue of the *Case Alumnus* has a two-page spread honoring Walter L. Seelbach of the class of 1910 for his recent election to the presidency of the American Foundrymen's Society. The editors of that publication have done a splendid job in picturing the great amount of work which Walter has undertaken in the service of the foundry industry. The tribute is richly deserved.

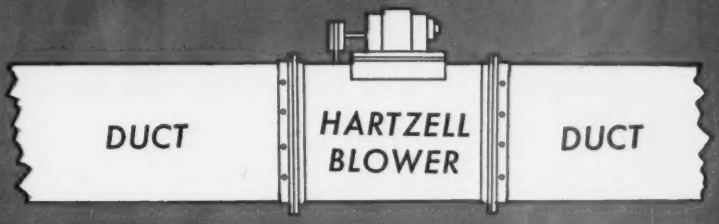
—o—

We Take a Bow: Late last year, a producer of foundry supplies presented his representative in Switzerland with a subscription to the foreign edition of a popular American publication. The note of thanks was so interesting that the producer of supplies has passed it along to us, and we give it to you:

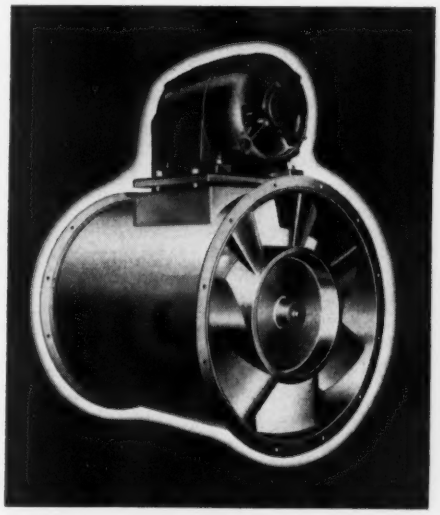
"We acknowledge receipt of the one-year's subscription to 'Selection du Reader's Digest' you offered us for Christmas and New Year, and thank you very much for your kindness. If we may express a wish for the future, we should say that we prefer FOUNDRY.

"We hope you do not mind our frankness, and thank you once more for your gift."

Our hats off to a man of discrimination. And we know that come Thanksgiving, the big snows and Christmas, things this year will be different. F.G.S.



the HARTZELL vaneaxial blower is *EASY* to install

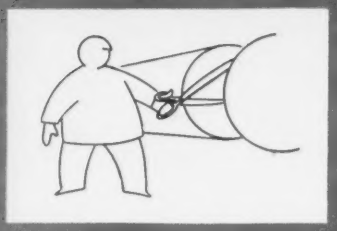


A POWERFUL BLOWER

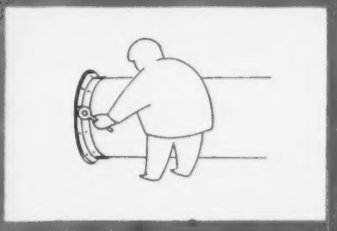
efficient against very heavy pressures

Maybe you didn't realize this: A single Hartzell 48″ Vaneaxial Blower can move 71,100 CFM against a half-inch static pressure, consuming just 50 HP, or 41,100 CFM against *seven-and-a-half* inches, with 65.3 HP. That's air-moving power against pressure! So, you see, there's no need to put up with clumsy, power-wasting air-moving devices which require an engineering crew for installation and clutter up valuable floor space. Get the *complete* economy of Hartzell Vaneaxial Blower design and construction . . . economy which begins with purchase price and installation and saves your money year after year.

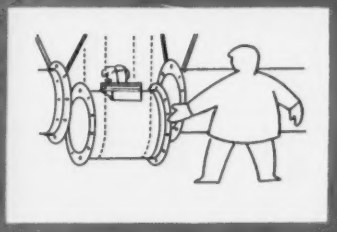
cut out a duct section same length as blower



bolt angle-iron flanges to duct ends



bolt the blower to the duct ends just installed, and brace duct flanges



And that's all — ***just make electrical connections and you're done!***

CLIP AND MAIL THIS COUPON NOW FOR INFORMATION

HARTZELL PROPELLER FAN CO.
Div. of Castle Hills Corp.
PIQUA DEPT. Q **OHIO**

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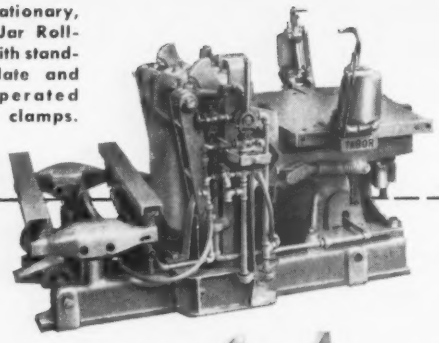
PROPELLER-TYPE FANS AND BLOWERS—ROOF VENTILATORS—UNIT HEATERS • ENGINEERING OFFICES IN PRINCIPAL CITIES

22" Stationary, Plain Jar Rollover with standard plate and air-operated single clamps.



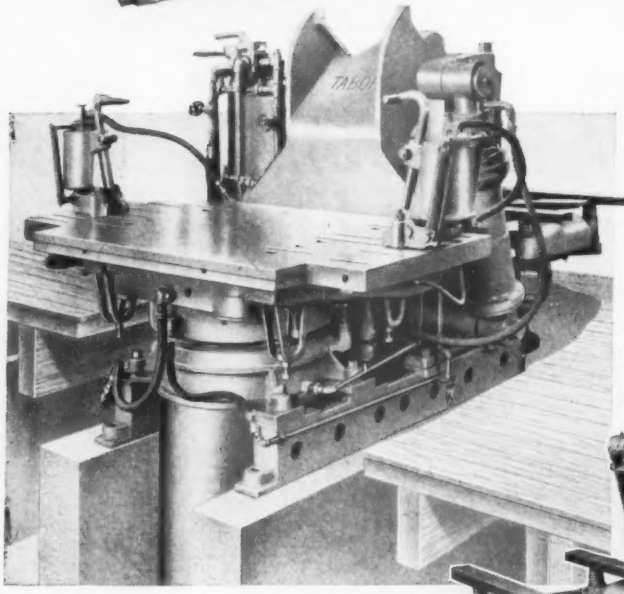
Why TABOR

Pictured here are three Tabor Rollovers—ranging in capacity from 600 to 3,000 pounds—that are "polishing halos" for foundry production superintendents the world over.

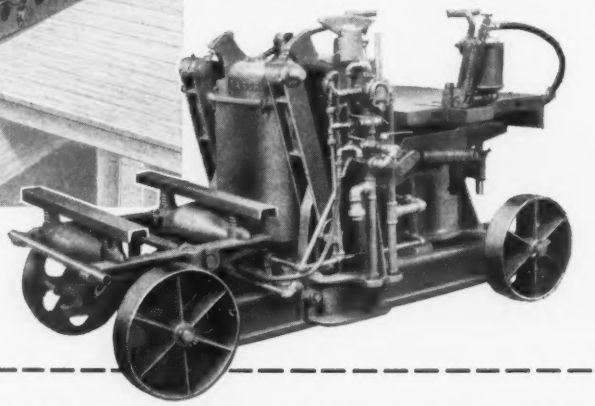
All are *completely* power operated. You can choose between plain jar or shockless jar (so *shock-free* that a finished mold awaiting removal on the drawing side will not be damaged if the operator fills and jars the next mold). The 22" and 30" Shockless Jar Rollovers are portable.

All incorporate Tabor's famous air-on-oil principle for a smooth, perfect draw. All perform up to full rated capacity, completing a cycle of operations in the *fractional part of a minute.*

Study the other features emphasized here. Write for Bulletin #514, just off press, and team up with Tabor for a quick and happy solution to any Rollover problem.



40" Rollover with standard plate and air-operated single clamps.



30" Portable, Shockless Jar Rollover with standard plate and air-operated single clamps.

Now... TABOR'S NEW PLATE-LOCKING DEVICE IS STANDARD EQUIPMENT ON MACHINES SHOWN

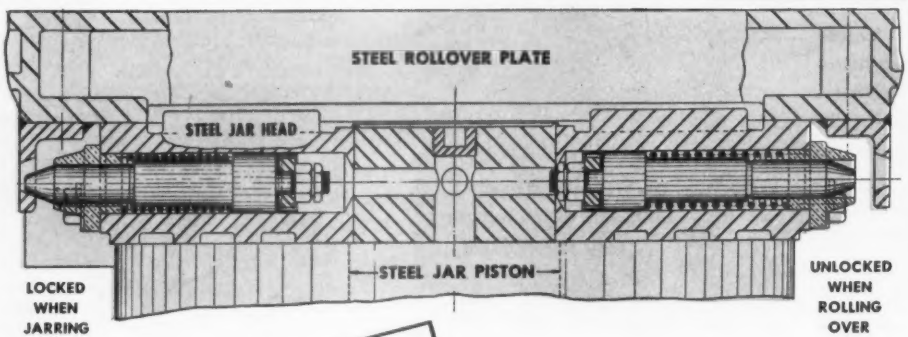


Plate wobble when jarring is gone forever, and the sketch shows why. Rollover plate and jarring head are locked into *one rigid unit* the moment jarring air is introduced—a feature exclusive with Tabor! 25% better jarring blow—equal ram all over the mold—no "secondary jolt"; plate and head last longer—no plate wobble, even when handling work with uneven weight distribution.

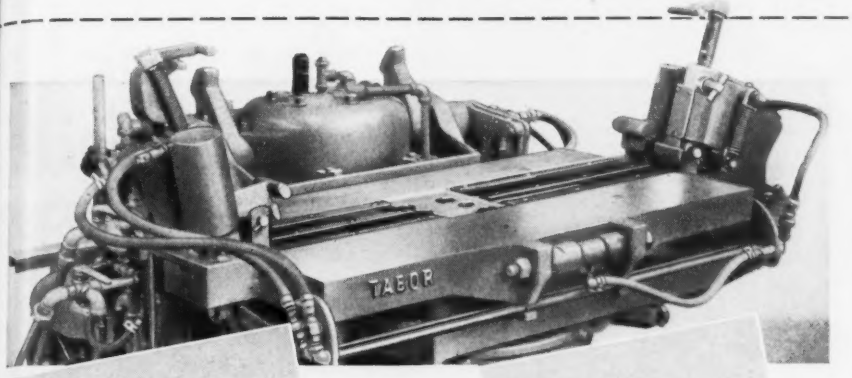
Note for long life—Rollover Plates, Jar Heads, and Jar Pistons on machines shown here are made from *steel castings or forgings*—another newly-adopted standard!

REPRESENTATIVES

Snyder Foundry Supply Company, Los Angeles, Calif.; The Pacific Graphite Company, Inc., 40th & Linden Sts., Oakland 8, Calif.; Carl F. Miller & Company, Seattle, Washington; Harry H. Reich, Trussville, Ala.

save labor...

Rollovers Work Miracles!



Core box clamped.

Core box and core plate clamped.

ANOTHER PRODUCTION BOOSTER—QUICK CHANGEOVER PLATE and DOUBLE CLAMPS!

Designed for super-speed changeover. Air-operated, double clamps slide in grooved rollover plate. All four clamps operate independently. Hold core box and core plate to machine without need for other clamping devices. Clamp pattern boards, flasks, bottom boards. Adjust immediately to new pattern board sizes without need of set-up man or tools. All machines shown here available with standard plate and single clamps or with quick changeover plate and double clamps.

MODERNIZE YOUR PRESENT TABOR ROLLOVER!

If your present Tabor Rollover is in the 600 to 3,000 pound capacity range, you can easily install any or all of these new features to great advantage. Give it the benefit of a plate, jar head, and jar piston made of *steel*. Add the new plate-locking device, whether or not your plate needs replacing. Or, substitute a quick changeover plate with double clamps for greater versatility.

SPECIFICATION TABLE

Size of Machines	Sizes of Rollover Plates		Length of Pattern Board when using Flask Clamps		Height Plate from Floor		Max. Space for over-all depth of Flask, Pattern Board and Bottom Boards	Draw	Capacity (lbs.)
	Width	Length	Min.	Max.	Plain Jar	Shockless Jar			
22″	22″	42″	16″	43″	25″	29″	17½″	10″	600 lbs.
30″	30″	40″	20″	53″	27¾″	32¼″	20½″	12″	1000 lbs.
40″	40″	50″	24″	56″	15″	15″	*43″ Minus draw required	15″	1500 to 3000 lbs.
40″	40″	60″	24″	66″	15″	15″	*43″ Minus draw required	15″	1500 to 3000 lbs.

*40″ machines can be furnished with 55″ max. space for over-all depth, which allows approx. 20″ draw. (Height of plate from floor—20″)

The TABOR Manufacturing Co.

SINCE 1884 MANUFACTURERS OF FOUNDRY MOLDING MACHINES

6225 TACONY STREET • PHILADELPHIA 35, PENNA.

Export Department, 765 Drexel Bldg., Phila. 6, Pa.

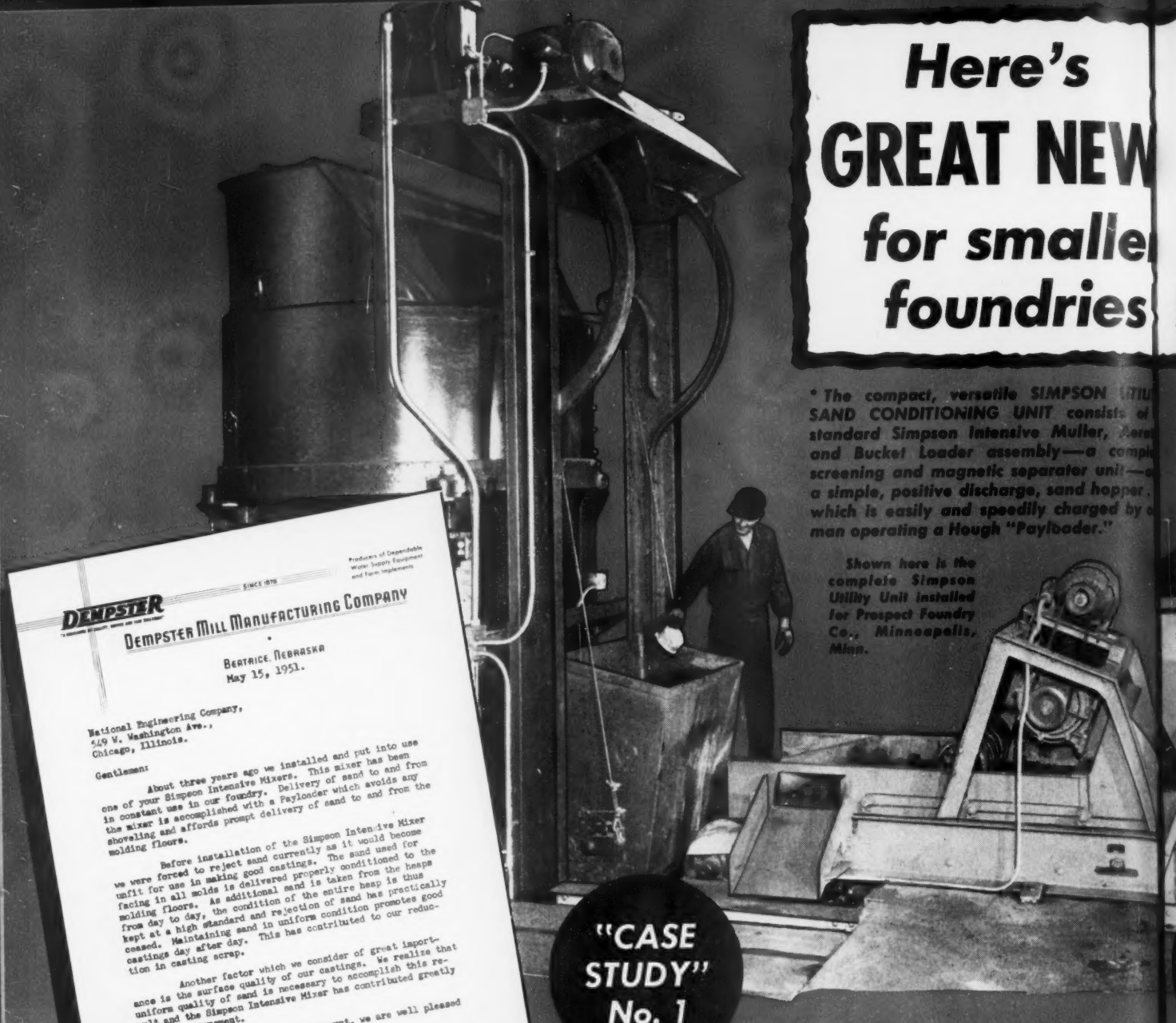
. . . buy Tabor

FOUNDRY EQUIPMENT MANUFACTURERS ASSOCIATION INC. MEMBER FEMA

Here's GREAT NEW for smalle foundries S

The compact, versatile SIMPSON UTILI SAND CONDITIONING UNIT consists of standard Simpson Intensive Muller, Hora and Bucket Loader assembly—a compl screening and magnetic separator unit—a a simple, positive discharge, sand hopper, which is easily and speedily charged by a man operating a Hough "Payloader."

Shown here is the complete Simpson Utility Unit installed for Prospect Foundry Co., Minneapolis, Minn.



Producers of Dependable Water Supply Equipment and Farm Implements

DEMPSTER — SINCE 1870

DEMPSTER MILL MANUFACTURING COMPANY

BEATRICE, NEBRASKA

May 15, 1951.

National Engineering Company,
549 W. Washington Ave.,
Chicago, Illinois.

Gentlemen:

About three years ago we installed and put into use one of your Simpson Intensive Mixers. This mixer has been in constant use in our foundry. Delivery of sand to and from the mixer is accomplished with a Payloader which avoids any shoveling and affords prompt delivery of sand to and from the molding floors.

Before installation of the Simpson Intensive Mixer we were forced to reject sand currently as it would become unfit for use in making good castings. The sand used for facing in all molds is delivered properly conditioned to the molding floors. As additional sand is taken from the heaps from day to day, the condition of the entire heap is thus kept at a high standard and rejection of sand has practically ceased. Maintaining sand in uniform condition promotes good castings day after day. This has contributed to our reduction in casting scrap.

Another factor which we consider of great importance is the surface quality of our castings. We realize that uniform quality of sand is necessary to accomplish this result and the Simpson Intensive Mixer has contributed greatly to this improvement.

Taking everything into account, we are well pleased with the operation of this equipment.

Very truly yours,
DEMPSTER MILL MANUFACTURING COMPANY.

Clyde B. Dempster.
PRESIDENT.

CBD:AW

"CASE STUDY" No. 1

DEMPSTER MILL MFG. CO.

READ the accompanying letter from Mr. Clyde B. Dempster, President of Dempster Mill Manufacturing Company . . . it tells, in straight, factual terms, how their SIMPSON Utility Sand Conditioning Unit has resulted in: (1) Prompt delivery of sand to and from molding floors; (2) All facing sand *properly* conditioned; (3) Sand rejection practically nil; (4) Uniformly good castings; (5) Reduction in casting scrap; and (6) Better surface quality of castings due to uniform quality of Simpson-mulled sand.

The Simpson Utility Sand Conditioning Unit is *engineered for expansion.* With a minimum initial investment, small and medium size foundries can have the advantages of larger, expensive equipment at a fraction of the cost . . . but with all the advantages of higher production and improved casting quality.

• • • •

LEFT: Close-up of the Simpson Utility Sand Conditioning Unit installed in the Dempster Mill Manufacturing Company grey iron foundry, Beatrice, Nebraska. Note use of "Payloader," eliminating hand shoveling.

the SIMPSON *Utility* SAND CONDITIONING UNIT*

. . . engineered for **EXPANSION**

"CASE STUDY" No. 2

PROSPECT FOUNDRY CO.

HERE is another progressive foundry that has capitalized on the time and money-saving advantages available to small and medium size foundries through the use of Simpson Utility Sand Conditioning Units . . . with Simpson Intensive Mullers as the heart of these units.

As Mr. S. J. Sitarz, Prospect Foundry Manager points out in his letter, their Simpson Unit has relieved them of several "headaches", which included problems relative to the control of moisture, flowability and casting finish.

With this Simpson Utility Unit, *one* man easily supervises the Muller, aided by *one* man operating the versatile Hough "Payloader" . . . an important factor in today's tight labor situation.

PROSPECT FOUNDRY CO.

GRAY IRON, LOW CARBON, ALLOY CASTINGS
GL. 2461 1825 WINTER ST. N. E.
MINNEAPOLIS 14, MINNESOTA

May 21, 1951

National Engineering Company
549 West Washington Boulevard
Chicago 6, Illinois

Gentlemen:

Since installing your No. 2 Muller, which we recently purchased, we have been relieved of several headaches. Some of the more serious problems which were solved include the ability to control moisture, as well as the control of flowability with an increase in green strength. Their control has given us a very fine casting finish.

We are pleased to state that we formerly used 3 men all day with our smaller unit, whereas with your new installation we are using one man all day, and a tractor man about half a day.

Sincerely yours,

PROSPECT FOUNDRY CO.

S. J. Sitarz
Manager

SJS/jkj

Here are just a few of the benefits you get with the SIMPSON Utility Unit: *Better Castings—Better Working Conditions—No Wasted Floor Space—Saving in Manpower—Less Scrap—Refuse-free Sand—High Flowability—and many other advantages.*

Write for further details, or send for Bulletin 490, which describes National "Progressive" units—engineered for expansion.

SIMPSON *Intensive* MULLERS

NATIONAL *Engineering Company*

608 Machinery Hall Bldg. • Chicago 6, Illinois

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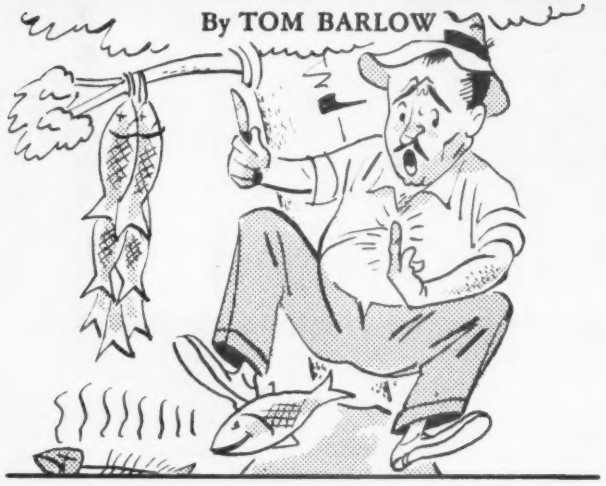
LET'S KICK IT AROUND

By TOM BARLOW



To clean a fish is quite an art;
You should be careful from the start;
And even when you do OK,
There still may be a better way.
—Ignominious

Do you remember the first time you cleaned a fish? I do. It took me about 45 minutes. When I finished, I washed up and went to town for a steak dinner. Good, too! However, since I enjoy fishing and continued to catch one now and then, I had to learn how to clean them. After many years of practice, I reached the point where I could clean a small bass in 15 minutes—and have enough fish to eat. I was happy. Then one day I watched another guy clean fish. He did it in three minutes—and had twice as much fish to eat. I tried his method and almost cut my arm off until he showed me the trick. Now I know two ways to clean fish—my way and the right way.

Would it be stretching a point to insinuate that a similar situation may exist in the foundry? There are so many ways of doing the same thing, but are you using the quickest and easiest? Sure, the way you are doing it works, but is it the best? Even if it worked equally well for your father and grandfather, is it the best today? Too often there is a reluctance to change just because the old way works. Maybe some other guy could show you an easier way, or one where you end up with "more fish to eat". (You can tell the bass season is close; everything I see reminds me of fish; I heard a better version of that punch line at the convention.)

Just for convenience, let us consider synthetic sand. By pure coincidence, that is our specialty. There are three basic types of synthetic sand bonds: Revivo, Dixie Bond and Black Hills Bentonite. Other bonds like Balanced Revivo and Westonite are modifications of or additions to the Big Three. We produce all three, and many variations, not just because we like to humor the whims of foundrymen (bless them!), but because all three are needed by the industry. Different clays do different jobs best. The question is, *Is the correct clay always being used for the job?* I can answer that, teacher. The answer is "no". There are many cases where Black Hills is being used on jobs that should use Dixie Bond, for example. Why?

Perhaps one reason for some confusion in the choice of bond clay is the word "substitute". Too often we say "Substitute Dixie Bond for Black Hills". That leaves an incorrect impression. If Black Hills is the best and right clay for the job, Dixie Bond is no substitute. But frequently Black Hills or Revivo is assigned to jobs which could better be handled by Dixie Bond. Then Dixie Bond is more than a substitute: it is a correction; it is entitled to be called progress, improvement, or what have you.

A lot of money can be saved by using the right clay for your job or your foundry. Or it may require the proper combination of two clays. In either case, why wait until you have sand trouble before considering a change in sand practice? Maybe what you are doing now *is* the best and cheapest—but are you sure? Maybe you are losing money every day, or at least making less than you should.

I illustrate this little sermon by reference to Dixie Bond for a very definite reason. As bond clays go, Dixie is the baby, the newcomer. A lot of foundrymen have never actually tried it or used it, or even investigated the stuff. Fortunately, a number of foundries have. The use of this type clay has tripled (yes, sir, that's 300%) in the last four years. Its application has spread as to both types of work and number of foundries. It is particularly popular in high production shops, such as automotive, because of high flowability (fast production). It is also popular in jobbing shops because of easy mixing, even with sand cutters, and easy shake-out. In other words, it has found use in those applications where it is the best clay for the job.

Now that you have finished reading today's lecture on sand, try to answer the following questions (truthfully—no cheating) and rate yourself as a prospect for Dixie Bond (no prizes):

1. Do you cast light and medium-section gray iron?
2. Do you cast bronze, brass and other non-ferrous?
3. Is your sand lumpy at the shake-out?
4. Is your sand gummy, lacking in flowability?
5. Do you like to get the most for your money?
6. Do you want better finish?
7. Do you want higher permeability?
8. Do you know any blondes, brunettes or redheads?

If the answer to any question from one through seven is "yes", you are a prospect for Dixie Bond. Next time one of our gang stops in, ask him about it. If No. 8 is the only question you got right, I'll stop and see you myself.

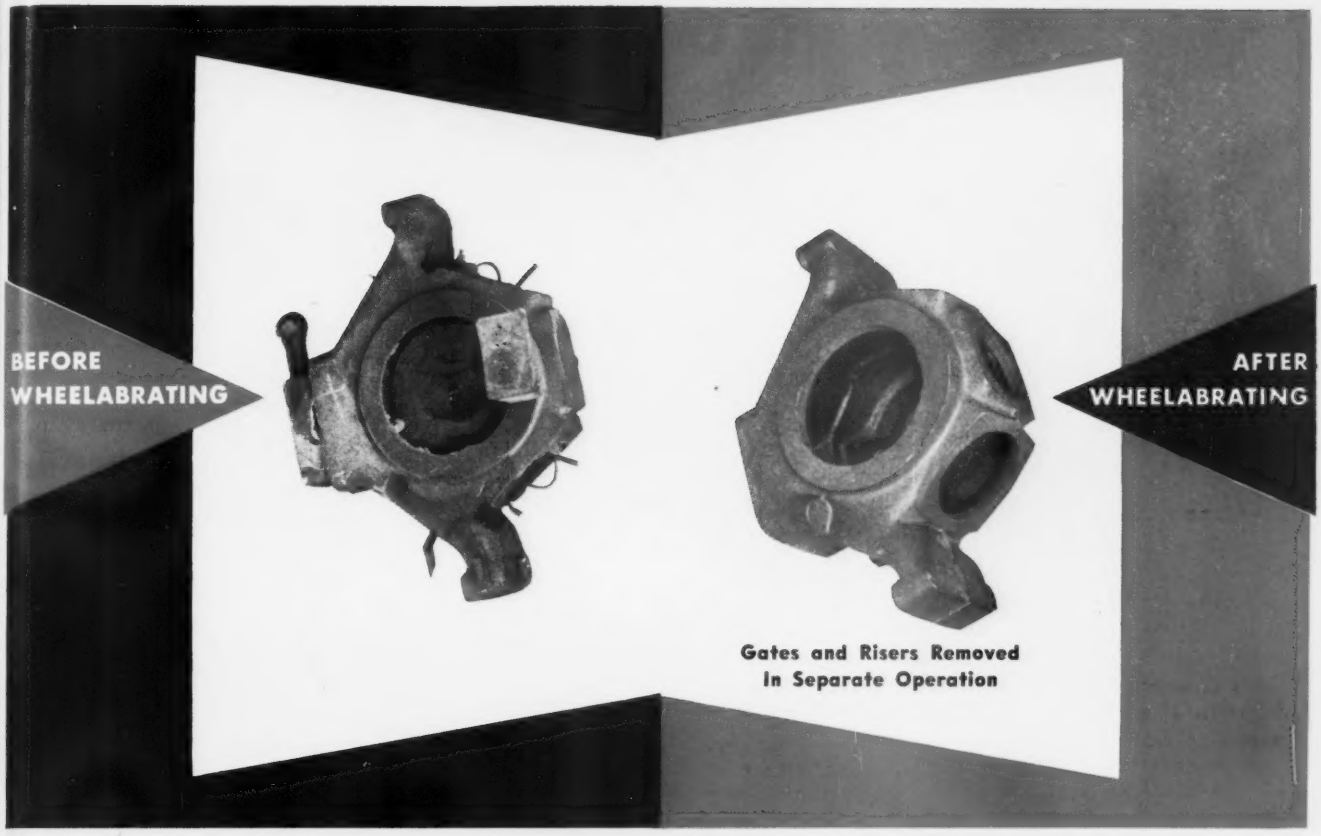
★ ★ ★

EASTERN CLAY PRODUCTS, INC.

"Bonding Clays Sold With Service"

JACKSON, OHIO

DIXIE BOND • BLACK HILLS BENTONITE • REVIVO BOND • REVIVO SUPER BOND • BALANCED REVIVO



cleaning time cut 15,000 man hours yearly

WITH WHEELABRATOR® AIRLESS BLAST CLEANING

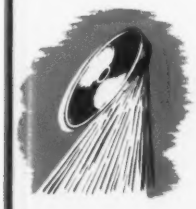
SUPERIOR FOUNDRY, INC. OF CLEVELAND, OHIO reduced cleaning time from 96 to 40 man hours daily by installing a Wheelabrator Monorail Cabinet which handles all work formerly done by 3 tumbling mills and 2 blast tables.

INVESTMENT RETURNS 50% YEARLY. Half the cost of this equipment was returned the first year through savings effected in manpower, reduced maintenance, decreased storage space, power costs and increased cleaning room efficiency.

75% LESS MAINTENANCE. Maintenance of the former equipment required four men 8 hours a day. One man now does this work in 8 hours. In addition there has been a 40% saving in repair parts.

CLEANING QUALITY IMPROVED. Customers appreciate the improved appearance of the Wheelabrated castings which have a bright, silvery, uniform finish free of all sand and scale.

HERE'S HOW YOU CAN SAVE. An expert analysis of your cleaning problems by one of our engineers will give you complete facts needed to compare your present practice, or any other cleaning method, with the results you can get with the world-famed airless Wheelabrator. Why not take this action soon? Doing so may put thousands of dollars on the profit side of your business every year.



WHEELABRATOR— The perfected airless centrifugal blast unit pioneered by *American*. Slashes cost and cleaning time. Conserves power, labor, space. Cleaning perfection results in longer tool life, faster machining and grinding, easier inspection.

American
WHEELABRATOR & EQUIPMENT CORP.
505 S. Byrkit St., Mishawaka 2, Indiana

WORLD'S LARGEST BUILDER OF AIRLESS BLAST CLEANING EQUIPMENT

MELTRITE

PIG IRON

LIVING UP TO ITS NAME

MORE USED THAN ANY OTHER MERCHANT PIG IRON

P M

PICKANDS MATHER & COMPANY

UNION COMMERCE BUILDING • CLEVELAND 14, OHIO

CHICAGO • CINCINNATI • DETROIT • DULUTH • ERIE • GRAND RAPIDS
GREENSBORO • INDIANAPOLIS • MINNEAPOLIS • ST. LOUIS • WASHINGTON

IRON ORE • PIG IRON • COAL • COKE

SIXTY-EIGHT YEARS OF
SERVICE TO INDUSTRY

Lynchburg Likes Worthington Air

As you probably know, Lynchburg Foundry Co. in Lynchburg, Virginia has one of the most modern plants in the country.

They use compressed air to power much of their work. With compressed air, they get *dependable* power and lower costs of operation and maintenance.

And with their *Worthington* Air Compressors, they get lowest-cost compressed air and longest compressor life.

*Reg. U. S. Pat. Off.

Lowest-Cost to Install and Operate

A Worthington DC-2 was installed in 1945—a horizontal duplex direct-connected compressor with Worthington's famous Feather* Valve (lightest, tightest, most efficient ever made) . . . automatic variable capacity control, the most simple, accurate and flexible control available . . . and a high-efficiency intercooler that needs less water, power, attention.

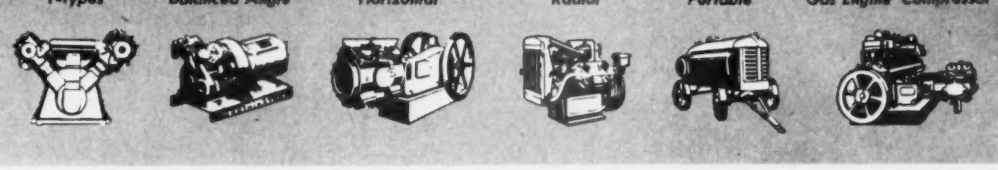
In 1948, a Worthington YC-2 was added. This unit comes *pre-assembled*—no alignment problem, no erecting engineer needed. Its economical operation comes from its balanced Y-frame (for higher rpm), Feather* Valve and 3- and 5-step variable capacity control.

So take a tip from Lynchburg and get to know why *there's more worth in Worthington*. Write for Air Compressor bulletins to Worthington Pump and Machinery Corporation, Compressor Division, Buffalo 5, New York.

WORTHINGTON

K.1.5

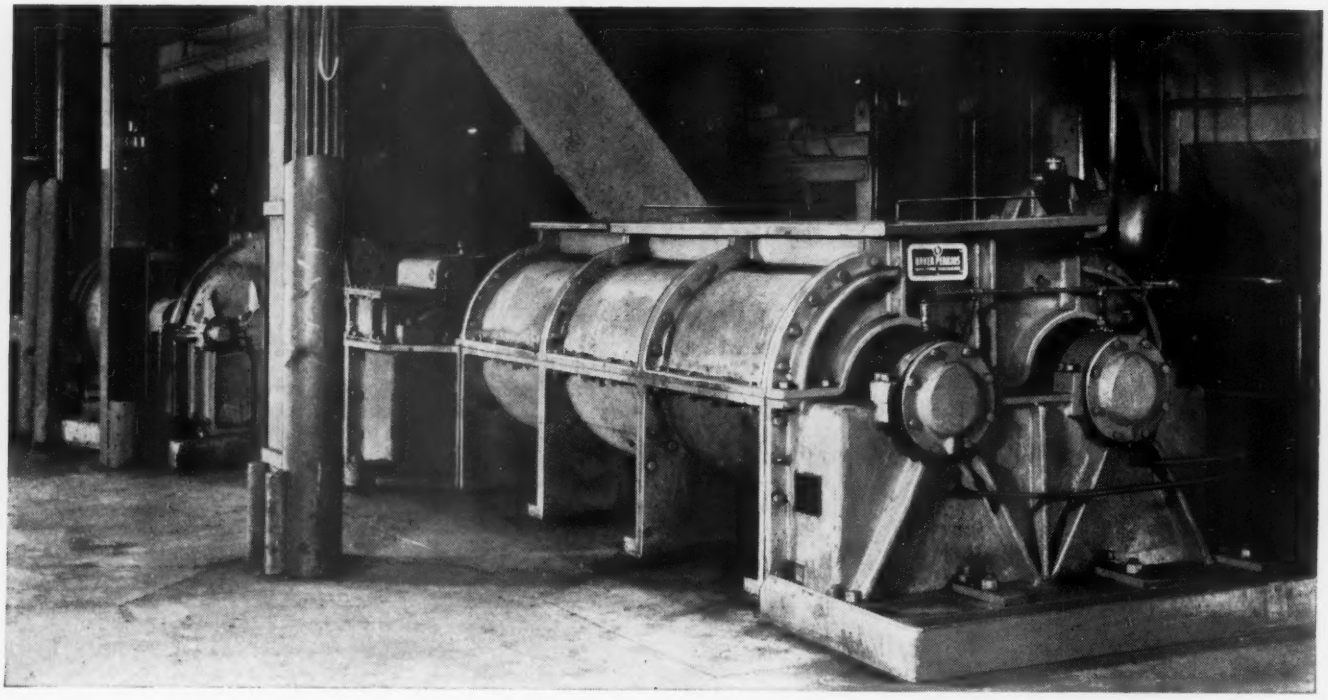
NO OTHER COMPRESSOR WILL OUTPERFORM A WORTHINGTON



17,280 TONS

OF MOLDING SAND PER 3-SHIFT DAY

processed by Baker Perkins mullers in world's biggest grey iron foundry



Six Baker Perkins Continuous Mullers are on the job at the world's biggest grey iron foundry helping to meet tough, tight schedules that depend on high daily production. Each B-P 5A Muller is conditioning 120 tons of molding sand each hour during an 8-hour shift. In the course of a 3-shift day, the six B-P Mullers handle the staggering total of 17,280 tons of sand that comes to the molding lines thoroughly mixed and tempered. Baker Perkins Continuous Mixers are ideal for processing molding sand on a big scale. Unique blade arrangement in B-P Mullers thoroughly mulls and aerates the tumbling sand mass, and each grain of sand is correctly coated with bond. B-P Mullers will deliver an uninterrupted flow of 30 to 120 tons of good sand per hour depending upon the size unit. Baker Perkins Continuous Mullers produce improved sands that mean better castings and lower scrap loss. They dependably meet the demands of high production automotive foundries and they can do the same for you. Write, wire, or phone for the full story on Baker Perkins Continuous Mullers.

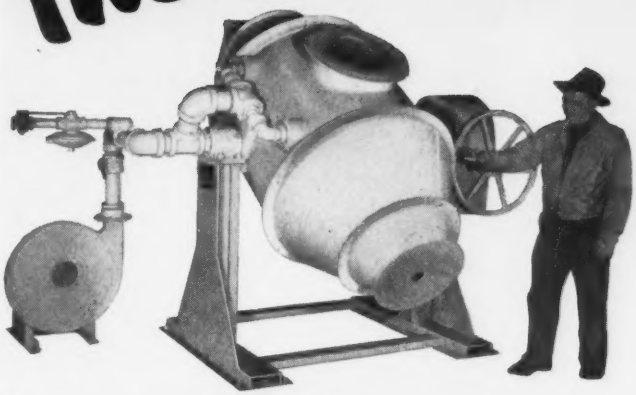
BAKER PERKINS INC.

SAGINAW, MICHIGAN

189

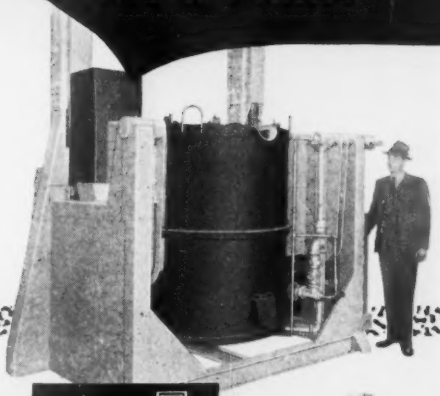
The Foremost Furnaces

for Melting any type of Non-Ferrous Metals in Foundries, Die Casting and Permanent Mold Plants



STROMAN MODEL "BFC" HAND TILT BARREL TYPE MELTING FURNACE FOR ALUMINUM

Featuring "Tangential Firing" which produces a most efficient combustion condition, creating a melting atmosphere that keeps metal loss and dross accumulation at a minimum. Charges through the top or rear door which is also used for drossing metal and cleaning the furnace. Built in 500 lb. capacity and larger. Oil or gas fire.

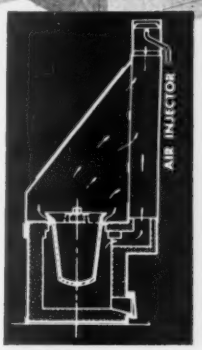


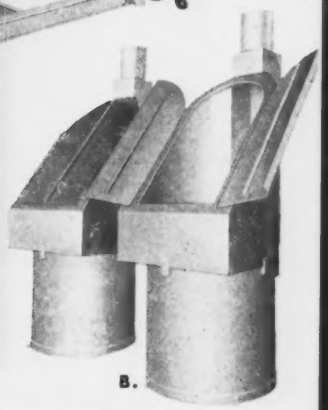
A.

STROMAN MAGNESIUM AND ALUMINUM MELTING AND HOLDING FURNACES

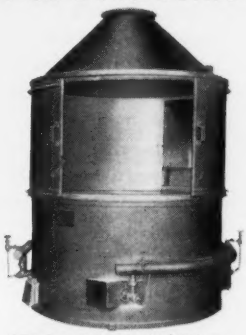
A. Hydraulic Tilt Magnesium and Aluminum melting furnace handling from 500 to 3000 lbs. of aluminum. Incorporates the famous Stroman Stationary Lip Pour, which creates a constant pouring arc at any desired pouring speed. Saves time and metal.

B. Stationary Super-Heating or Melting Furnaces, Type S. F. Designed to deliver the correct super-heat to magnesium after it has been melted in larger furnaces, and before it is poured into the molds. Can also be used for breakdown or holding. They have all safety features. Are available for cast steel pots or fabricated steel pots. Furnaces may be equipped with hoods if so desired, for the venting of combustion and other gasses. Write for bulletin No. 100.





B.



STROMAN IRON POT MELTING FURNACES FOR ZINC OR ALUMINUM

These furnaces are highly recommended as breakdown furnaces for zinc and aluminum die casting and permanent mold plants. They also excel as holding furnaces. They can be supplied either with or without hoods to exhaust fumes and heat. Their construction causes longest pot life and lowest fuel costs. Choice of automatic or manual controls and oil or gas fire. Capacities from 212 to 14,000 lbs. zinc.

Write for Bulletin No. 115

STROMAN HAND TILT CRUCIBLE MELTING FURNACE FOR BRASS, BRONZE, ALUMINUM AND OTHER ALLOYS

Capacities from No. 40 to No. 500 Crucible. Most efficient in operation. Rugged construction assures longest life and trouble-free operation. Oil, Gas or Combination Fire.

Write for Bulletin No. 105

STROMAN TYPE "MC" ALUMINUM DIP-OUT REVERBERATORY FURNACE

Bath capacity from 500 to 10,000 lbs. Aluminum

A combination of breakdown and holding furnaces makes this the most economical furnace ever designed for aluminum melting. It can be used for melting, holding, alloying, fluxing, for either casting or producing ingots. Cold metal does not reach the molten bath. Hot metal is always available for dipping. No iron pots or crucibles to buy. Oil, gas or combination oil-gas fire. Complete automatic controls are available if desired.

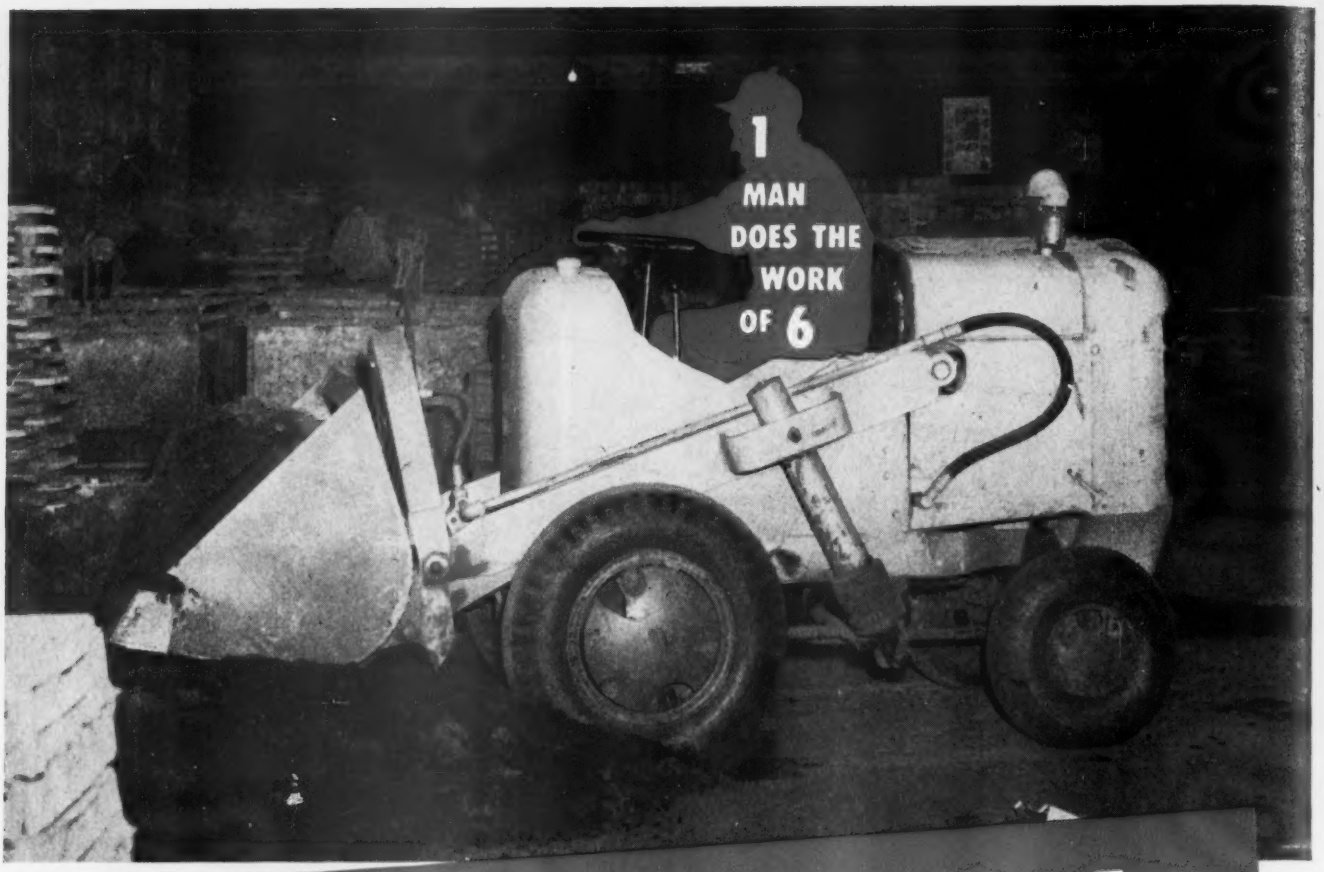
WRITE FOR COMPLETE CATALOGUE ON ALL TYPES OF FOUNDRY EQUIPMENT

Printed in U.S.A.

STROMAN FURNACE & ENGINEERING CO.

DIVISION OF

THE PETERSEN OVEN CO. • 9900 FRANKLIN AVE. • FRANKLIN PARK, ILL.



PAYLOADERS Can Help You Too

FOUNDRIES and metal-working plants in increasing numbers are installing Hough PAYLOADERS because they are a sure, proven way to lick rising costs, solve manpower shortages and increase output.

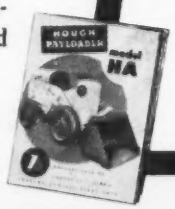
A PAYLOADER more than pays its way every day — actually pays for itself within a few months doing the many jobs listed here and doing them faster and cheaper . . . releasing manpower for more productive work.

The 12 cubic foot Model HA shown is the smallest of the PAYLOADER line that includes graduated sizes up to 1½ cubic yard bucket capacity. Every PAYLOADER is a complete, Hough-built tractor-shovel specifically designed with multiple reverse speeds and other features that insure fast, low-cost bulk material handling. They are backed by 30 years of material-handling equipment manufacture and are sold and serviced by a world-wide Distributor organization. The Frank G. Hough Co., 703 Sunnyside Ave., Libertyville, Ill.

Literature on any size PAYLOADER will gladly be sent without obligation.

On These Jobs

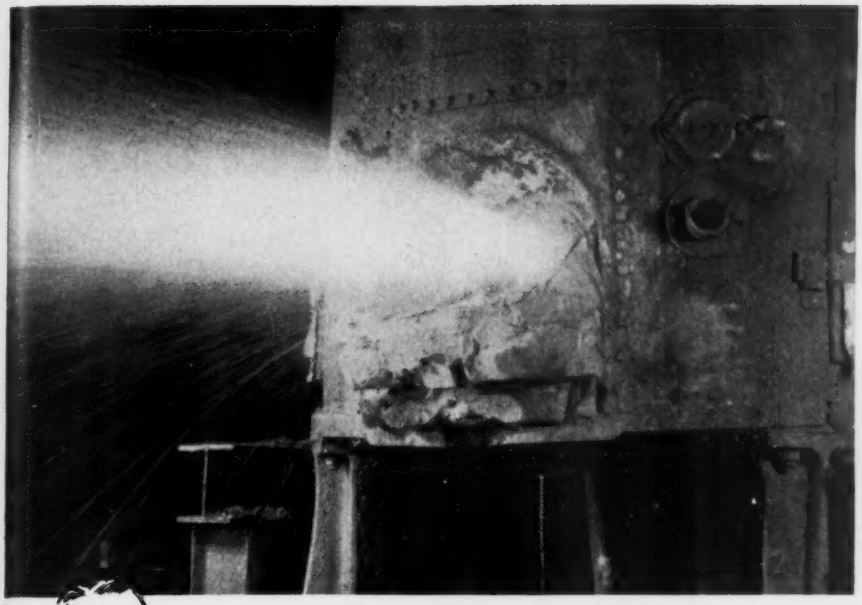
Unload box cars.
Carry sand, coke, scrap, limestone, etc., to storage.
Transport and distribute sand to molding stations.
Remove used sand from floors.
Windrow sand for the cutter.
Charge mullers, hoppers, tumbling barrels.
Feed conveyors, elevators, mixers, screenerators.
Clean up gangways, aisles and other areas.
Handle coal, ashes, cinders.
Handle scrap and small castings.
Maintain private roadways.
Do crane work—haul, push.
Remove snow.



SAY "HUFF"

PAYLOADER®

THE FRANK G. HOUGH CO. • Since 1920



INCREASED PRODUCTION per hour results from the fewer interruptions per campaign you get with Norton Crystolon* (silicon carbide) slag hole blocks, which resist slag action 5 to 15 times longer than fire clay blocks.

NOW . . . FEWER INTERRUPTIONS PER CAMPAIGN

If short-lived slag hole blocks are cutting down your production per hour you are *needlessly* wasting productive capacity. For, Norton Crystolon slag hole blocks consistently hold their hole size from 8 to 30 hours . . . depending on the type of cupola and the composition of your slag.

Made of hard, dense silicon carbide, Norton Crystolon blocks stubbornly resist slag erosion and corrosion at temperatures as high as 3050°F. More and more foundries report that no other blocks they have used last so long without softening, spalling or cracking.

Worth Comparing!

Give Norton Crystolon slag hole blocks a workout in your cupolas. Compare their performance with whatever you are now using. Maybe you, too, will reduce costly shutdowns and speed up the flow of vitally needed metals. For prices or more information, contact your nearby Norton representative or write us direct. Norton Company, Worcester 6, Massachusetts.

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Making better products to make other products better

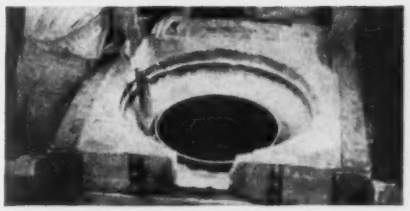
Special REFRACTORIES

Canadian Representative

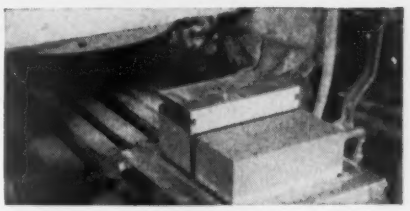
A. P. GREEN FIRE BRICK CO., Ltd. TORONTO, ONTARIO

How to Select The Right Refractory Cement:

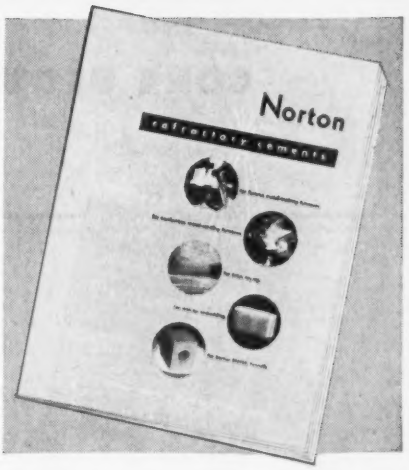
FOR TROWELING



FOR RAMMING



FOR PRESSING



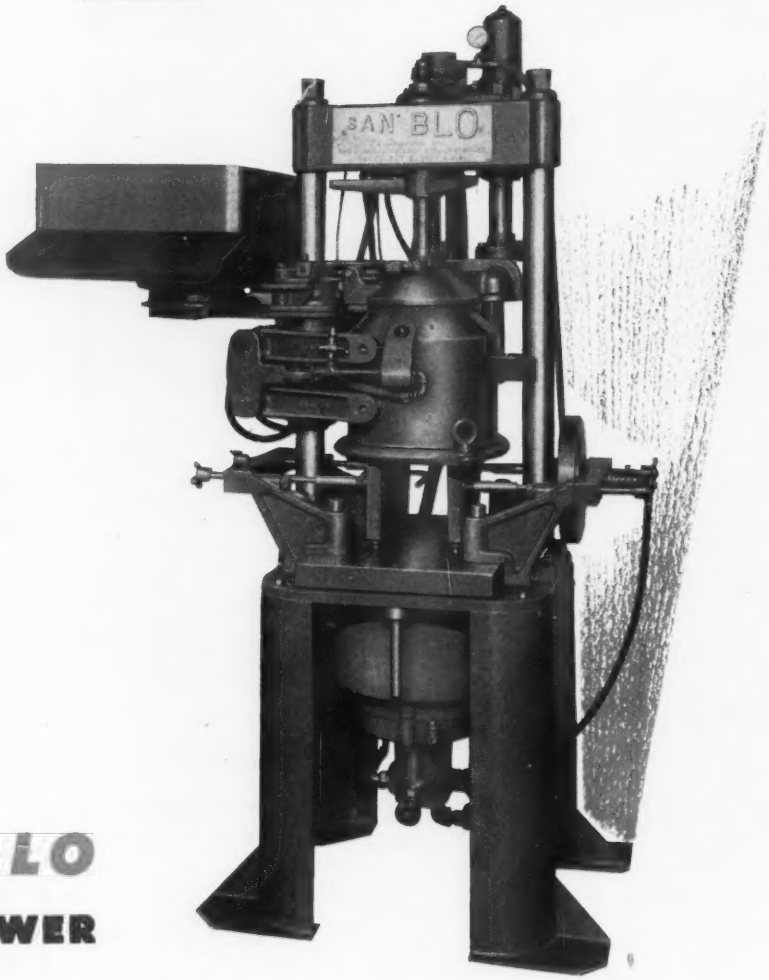
Write for Bulletin 863

. . . "the most helpful bulletin on refractory cements ever published" according to the hundreds of foundry and furnace men who are using its selection charts and installation directions. Write for your copy today.

NORTON COMPANY
304 NEW BOND STREET
WORCESTER 6, MASS.

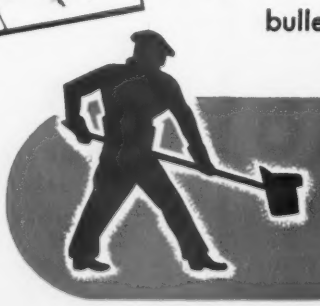
*Trade-Mark Reg. U. S. Pat. Off. and Foreign Countries

. . . blows all core mixtures!



SAN-BLO
CORE BLOWER

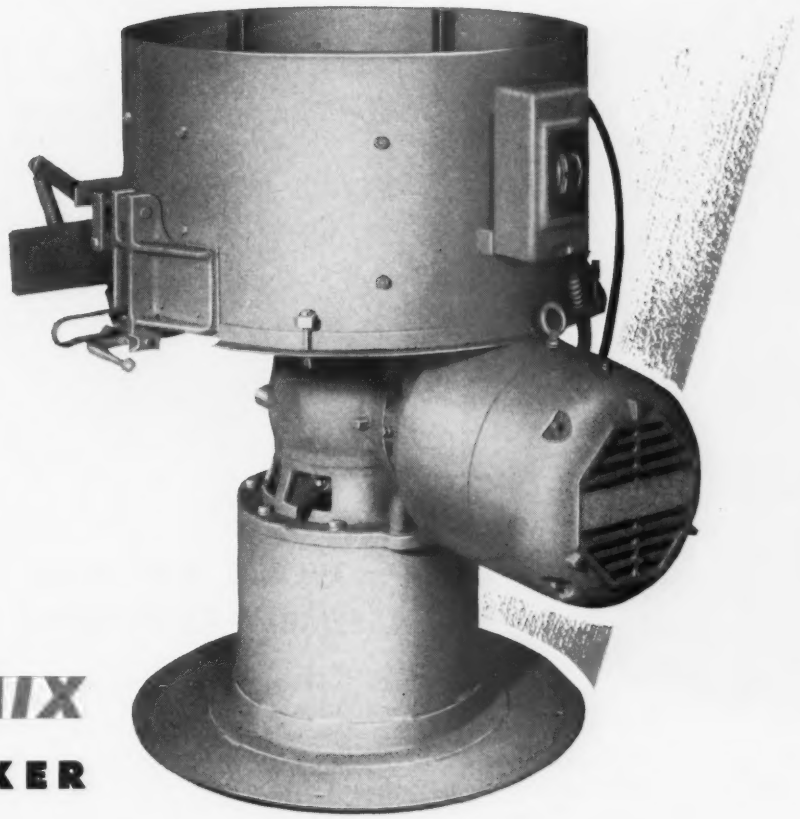
Iron, steel and non-ferrous foundries are boosting production and slashing core room costs with the new, all-purpose SAN-BLO. They're blowing cores and sand mixtures always rammed before . . . blowing sand with higher green strength and moisture content than ever before possible . . . eliminating core rods and driers in many cases. Foundries, large and small, are finding new economies in SAN-BLO. Why not investigate? Send for bulletin CB-2, today.



FEMA

The FEDERAL F N
4600 EAST T EE
CHICAGO • DETROIT • MILWAUKEE W YO

. . . small in size—big producer!

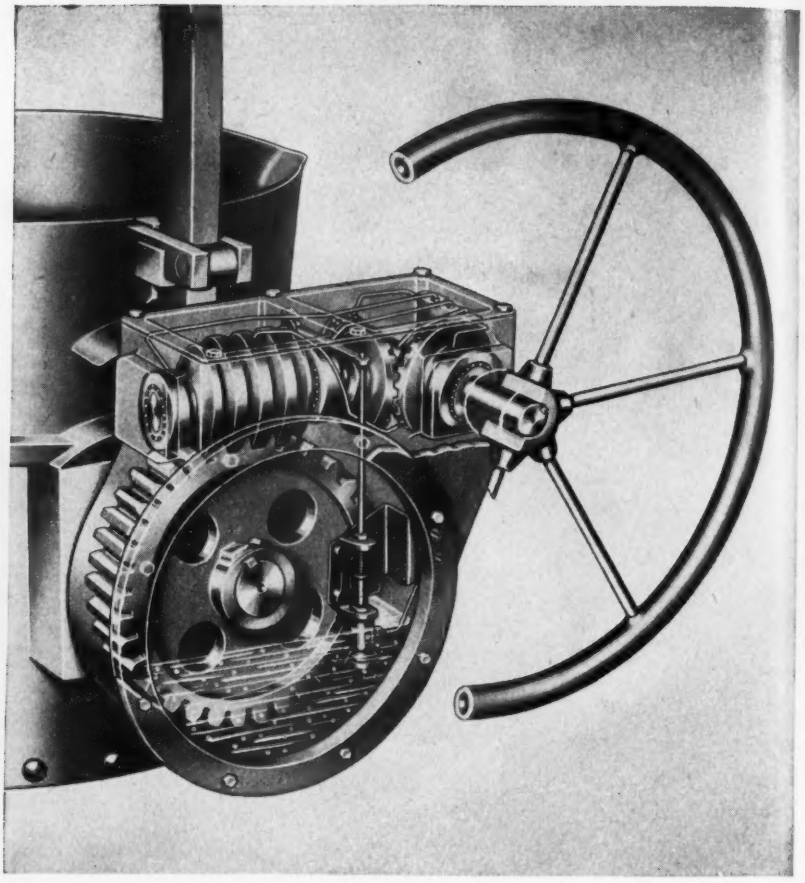


WHIRLMIX
SAND MIXER

There's economy in the new WHIRLMIX. It packs a lot of production in small size . . . mixes up to 4,000 lbs. per hour . . . at lowest cost. Batch size is 3 cubic feet, yet WHIRLMIX weighs but 1,060 lbs. Easily moved and doesn't require a foundation. Two flexible, spring steel arms mix sand quickly and thoroughly, without overheating or crushing sand grains. Reasonably priced and available for immediate delivery. Write today for 4-page bulletin.

NDRY SUPPLY *Company*
EET • CLEVELAND 5, OHIO
W YORK • CHATTANOOGA • RICHMOND, VA. • LOS ANGELES

New Worm Ladle Gearing ELIMINATES GASKET ADJUSTMENTS



. . . WORM AND BEVEL GEAR ASSEMBLY COMPLETELY ADJUSTABLE

- **Completely enclosed and self contained**
- **Automatic force-feed lubrication**
- **Positively self locking in any position**
- **Precision cut gears**

Here is another Industrial Equipment Company first . . . new, improved worm ladle gearing bringing *complete universal adjustability.*

Take a close look at the phantom view. Here is a one-piece, self-contained unit with all parts easily accessible. Your maintenance man can quickly make back-lash adjustments to pin-point accuracy and positive adjustment by adjusting the bearing lock nuts on all gears and worm. These nuts are easily reached and with working space to spare.

Unaffected by Heat

There is no connection between the bail and the gearing. No clearance for heat distortion is necessary, permitting an assembly almost to machine tool precision.

Industrial's new gearing is absolutely safe and positively self locking. The high ratio between worm and worm gear locks the ladle in any position. Incidentally, worm and bevel gears are of high tensile semi-steel and the worm is of high alloy steel. All are precision cut. Shafts are mounted on anti-friction bearings.

Now Standard Equipment

All Industrial geared ladles are now supplied with this outstanding new type of gearing. In addition, this gearing can be supplied for any Industrial worm geared ladles now in operation. *Write for details.*

Model 592T ladle with new type gearing. Also notice use of Industrial Equipment's much talked-about UNIVERSAL BAIL. This bail completely eliminates binding due to heat distortion or misalignment. Rigid bail also available.

Do you have our revised catalog No. 35?

Industrial
EQUIPMENT COMPANY
115 N. Ohio St., Minster, Ohio

LADLES • BOWLS • SHANKS • BAILS • TONGS • SPECIAL EQUIPMENT

Is this Your Work?

- ☐ Laboratory Melting
- ☐ Precision Casting
- ☐ Melting Gold, Silver, Platinum, other precious metals
- ☐ Melting Non-Ferrous Alloys up to 60 lbs.
- ☐ Melting Ferrous Alloys up to 30 lbs.

Get Closer Control with this *FASTER* Ajax-Northrup 20-KW. Furnace

If your melting calls for a hard-boiled combination of melting speed, superfine control, and overall economy, this Ajax-Northrup 20 kw. converter-operated induction furnace can do the job. Melts 30 lbs. of brass in 20 minutes. 17 lbs. of steel in 35 minutes. No carbon contamination—no oxidation. Precise control of composition and temperatures . . . even with alloys that are "impossible" to handle in other furnaces.

Self-tuning. No adjustments required while melting. No moving parts to wear out. Maintenance is limited to annual inspection of two electrodes. Flexible . . . easy, quick changeover from one alloy to another. Built also in 3, 6, and 40 kw. sizes. Generator operated units to 1200 kw. and 8 tons. Send today for free bulletins covering any melting or heating problem.

This is Your Bulletin

AJAX ELECTROTHERMIC CORPORATION
AJAX PARK • TRENTON 5, N. J.

Associate Companies

AJAX ELECTRO METALLURGICAL CORP.
AJAX ELECTRIC FURNACE CORPORATION
AJAX ELECTRIC COMPANY, INC.
AJAX ENGINEERING CORPORATION

123

AJAX NORTHRUP

HEATING & MELTING

SCENE: Pouring molds in large foundry
EQUIPMENT: JEFFREY MOLD CONVEYORS
REASON: To speed up production, reduce costs
OTHER UNITS: Flask Fillers, Sand Conditioning and Handling Equipment
WHAT TO DO: Send for a JEFFREY Foundry Engineer

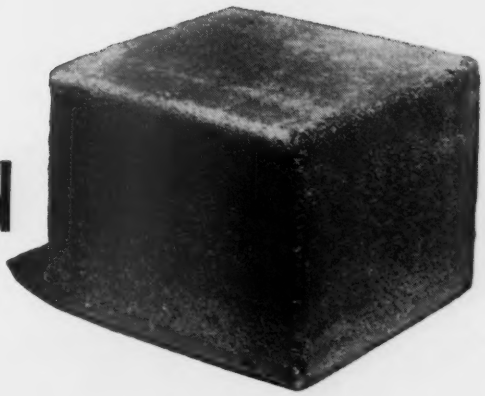
THE JEFFREY MANUFACTURING COMPANY ESTABLISHED 1877
907 North Fourth St., Columbus 16, Ohio

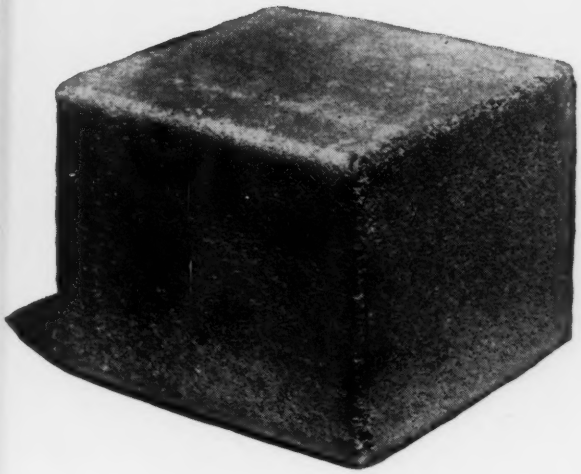
Complete Line of Material Handling, Processing and Mining Equipment

Baltimore 2 Boston 16 Cincinnati 2 Detroit 13 Jacksonville 2 Philadelphia 3 Salt Lake City 1
Beckley, W. Va. Buffalo 2 Cleveland 15 Harlan, Ky. Milwaukee 2 Pittsburgh 22 Scranton 3
Birmingham 3 Chicago 1 Denver 2 Houston 2 New York 7 St. Louis 1

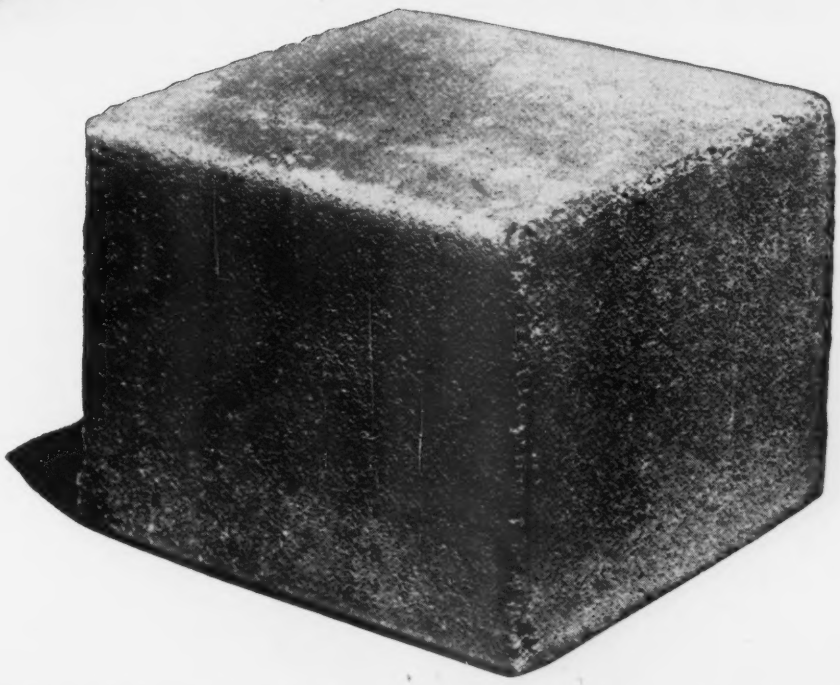
Jeffrey Mfg. Co. Ltd., Montreal, Canada
Jeffrey-Galion (Pty.) Ltd., Johannesburg, S.A.
The Ohio Malleable Iron Co., Columbus, Ohio
British Jeffrey-Diamond Ltd., Wakefield, England
The Galion Iron Works & Mfg. Co., Galion, Ohio
The Kilbourne & Jacobs Mfg. Co., Columbus, Ohio

MORE EFFECTIVE DEOXIDATION





FERROCARBO
TRADE MARK
Briquettes



- Made from silicon carbide specially processed for metallurgical use.
- Readily soluble in molten iron, providing thorough deoxidation.
- Super-heated iron of greater fluidity obtained; foundry variables reduced; cleaner, sharper castings poured.
- Easily added to cupola in uniform briquettes.

by CARBORUNDUM
TRADE MARK

Write or Phone our FERROCARBO Distributors:
KERCHNER, MARSHALL & CO., PITTSBURGH, Cleveland, Birmingham, Philadelphia and Buffalo
MILLER & COMPANY, CHICAGO, St. Louis and Cincinnati

● **FERROCARBO Briquettes** are manufactured under U.S. Patents 2,119,521 and 2,497,745. The process of making cast iron through utilization of silicon carbide is registered under U.S. Patent 2,020,171.

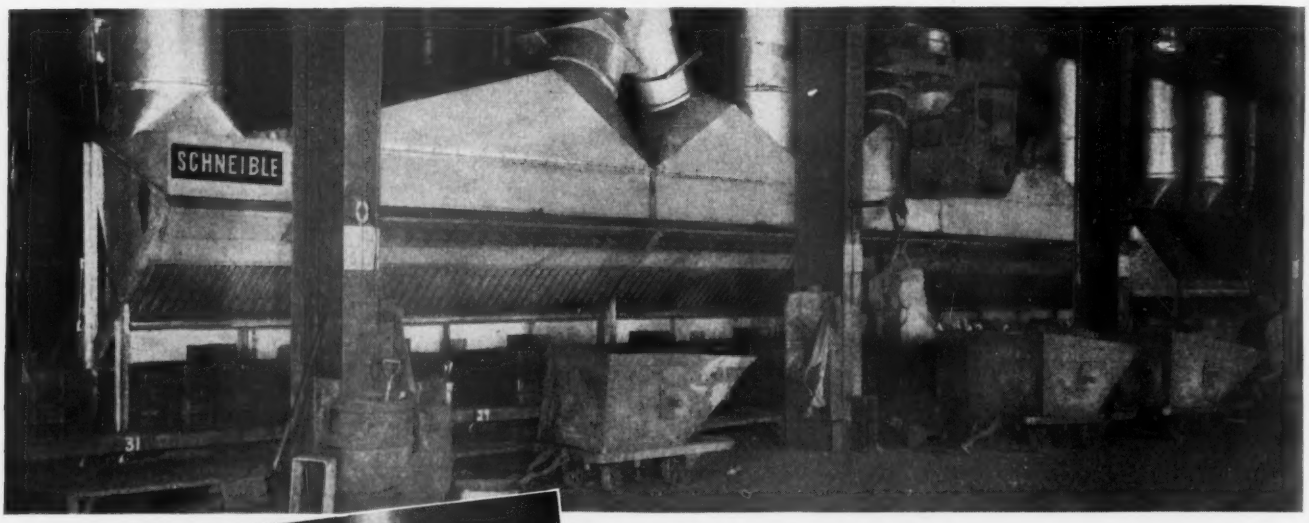
Made in Canada by the CANADIAN CARBORUNDUM COMPANY, LTD., Niagara Falls, Ontario
and Distributed in Canada by WILLIAMS & WILSON, TORONTO, Montreal and Windsor, *and by* KERCHNER, MARSHALL & CO., BUFFALO, N.Y.

"Carborundum" and "Ferrocarbo" are registered trademarks which indicate manufacture by The Carborundum Company, Niagara Falls, N.Y

Summer and Winter...

SCHNEIBLE COMPENSATING UNI-FLO HOODS

PROVIDE IDEAL POURING CONDITIONS



"Compensating Air" at the exhaust hood is the *latest Schneible improvement* in foundry ventilation for pouring operations.

This principle provides cooler building temperatures in summer because the air supply is taken from high inside the foundry. This hot air is naturally replaced by cool air from outside. In cold weather the compensating air is taken from outside the building, thus conserving loss of warm inside air. This lowers power plant output, effecting fuel savings.

The ventilation is improved by directional control of the air. Contaminated area can be blanketed with clean air without directly striking the workmen.

The *Schneible Compensating Principle* can be applied also for shake-out operations, mold cooling conveyors and other applications where large volumes of air are exhausted.

Our engineers are trained to help you cut costs and provide greater efficiency through better dust and fume control. (U.S. and Foreign Patents applied for.)

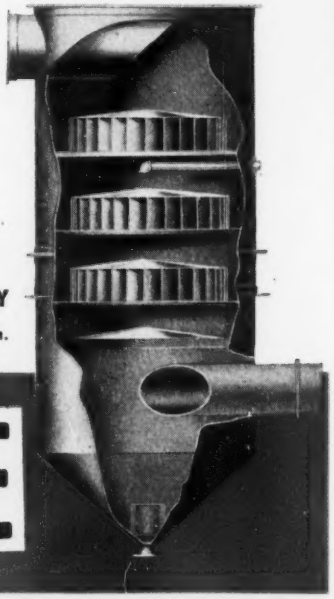
Free

Write for Bulletins Nos. 510, 450 and 47 which cover Schneible methods of ventilation and dust control.

MULTI-WASH COLLECTORS

Two models are available: the HC with capacities from 1500 to 36,000 c.f.m. or multiple units for larger capacities.

The JC—from 1000 to 36,000 c.f.m. capacity or in multiple units.



CLAUDE B. SCHNEIBLE COMPANY

2827 Twenty-Fifth Street • Detroit 16, Mich.

SCHNEIBLE

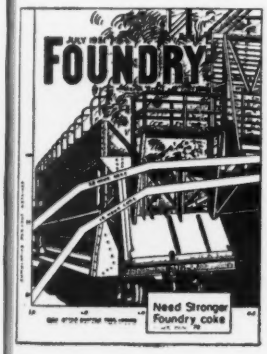
Late FOUNDRY News

June 25, 1951

MORE RATED ORDERS: Foundries are required by NPA to reserve a much larger portion of their capacity than formerly to fill rated orders in the third quarter. Reason is that, under CMP, more orders will have ratings because allotments of materials are broadened to cover both military and civilian products. Amended Order M-1 specifies that in one month foundries are not required to fill rated orders for more than the following percentages of their average monthly shipments the first eight months of 1950: Steel castings 80 per cent (75 per cent for stainless); gray iron 60 per cent (65 per cent for full alloy); malleable iron 65 per cent. The maximum percentage for brass and bronze foundries, under Order M-11, is 75 per cent (90 per cent for beryllium copper) of average monthly shipments the first three months this year.

COMPLETE CMP: It's a good bet that an all-inclusive CMP will go into effect the fourth quarter, replacing the open-end type which starts July 1 and which does not cover consumer durable goods manufacturers. The latter shortly will be asked to file CMP forms for fourth quarter production so that full information will be available if NPA should decide to close the plan's "open end." Meanwhile, small producers of Class B products have been relieved of the necessity of filing with NPA for their controlled material requirements, provided their quarterly needs do not exceed 5 tons of carbon steel, ½-ton of alloy steel (except stainless), 500 pounds of copper and copper base products, or 500 pounds of aluminum. Instead, they will use the rating DO-SU.

NEW FACILITIES: Certificates issued by the Defense Production Administration to permit five-year depreciation of new defense facilities numbered 1937 and involved $6.7 billion as of mid-June. Most recent foundry facilities authorized, and amounts involved, are: Wisconsin Centrifugal Foundry Inc., Waukesha, Wis., $85,400; Locomotive Finished Material Co., Atchison, Kans., $182,130; Standard Foundry Co., Worcester, Mass., $498,510; General Steel Castings Corp., Granite City, Ill., $698,995; Monarch Aluminum Mfg. Co., Cleveland, $50,000. Hanna Furnace Corp. has a $12 million certificate for an expansion program at Buffalo which may include a new blast furnace.



THE COVER: Pushing by-product coke from an oven at the Armco Steel Corp. plant, Hamilton, O.

NO SEACOAL CEILING: OPS has exempted seacoal facing from ceiling price regulation. It says there is no foreseeable shortage and that seacoal, where used, represents less than one-tenth of 1 per cent of the cost of making castings. An "extremely competitive situation" is said to exist in the 100,000-ton annual market for seacoal.

FOUNDRIES SAFER: Safety record of foundries has improved substantially the last two years. National Safety Council figures show the industry's frequency rate in 1950 was 13.2 lost-time accidents per million man-hours; in 1948 it was 21.06. Foundries still are below the average for 40 basic industries (9.3 last year), but whereas in 1948 only five industries had a worse safety record than foundries, in 1950 castings producers topped 13 other classifications.

NEW FACES: Francis E. Fisher, formerly assistant sales manager, Hydro-Blast Corp., Chicago, has been named assistant chief, Foundry Equipment and Supplies Section, General Industrial Equipment Division, NPA, Washington. He is expected to succeed Aubrey J. Grindle, present chief, when the latter returns later this summer to the presidency of Foundry Services & Equipment Corp. and Air Purification Corp., Markham, Ill. Richard F. Sentner, U. S. Steel Corp., Pittsburgh, is the new director of the Iron and Steel Division, NPA, succeeding Melvin W. Cole, who has returned to Bethlehem Steel Co., Detroit. Wallace B. Quail, on leave from Armco Steel Corp., Middletown, O., has been appointed deputy director of the division. Joseph W. Mullally, Anaconda Wire & Cable Co., has been made deputy director of the Copper Division.

GRAPHITE: After July 1 artificial graphite and carbon electrodes can be obtained only on allocation by NPA. Users will receive their allocation by filing Form NPAF-97 with NPA not later than the 10th day of the month preceding the quarter in which delivery is sought. Annual output of these products is

estimated at 100,000 tons. Users of 500 pounds or less quarterly are exempt from this order (M-66). Supplies of natural graphite also are somewhat tight. More than 90 per cent of it is imported and attempts are being made to boost receipts from Mexico, which last year supplied 50,000 tons. Ceylon is expected to furnish about 6000 tons this year; industry says this is not enough and has asked the government to curtail stockpiling until inventories are adequate. No serious shortage in the grade of Ceylon graphite used for foundry facings is in early prospect. However, crucible manufacturers are disturbed over the lag in receipts of Madagascar graphite. Very little of the year's estimated requirements of 4000 tons has come from that island so far.

COPPER ALLOCATION: NPA has been working on plans for complete allocation of refined copper, copper and copper-base alloy scrap, and brass and bronze ingots. This would require castings producers to file monthly applications for their estimated metal requirements. Scrap allocation is expected to alleviate the supply problems of ingot makers.

INDUSTRY MEN OUT: Department of Justice views on industrialists serving government agencies have had this effect: OPS has released three foundrymen (May *Foundry*, p. 123) who recently were part-time consultants without compensation in the Castings Section; the Munitions Board is appointing only full-time government employees as chairmen of industrial advisory committees. Maj. Gen. H. F. Griswold succeeds Frank G. Steinebach, editor, *Foundry*, as chairman of the Foundry Industry Advisory Committee to the Munitions Board and also heads that group's subcommittees.

LATE BRIEFS: Issuance of the OPS price regulation covering castings has been delayed, possibly for another month . . . Crucible Steel Casting Corp., Milwaukee, is acquiring Ebaloy Inc., Rockford, Ill., aluminum foundry . . . Full impact of material shortages will be felt about the beginning of 1952, the American Society for Testing Materials was told at its Atlantic City convention last week by DPA Deputy Administrator Nathaniel Knowles. He said expanding capacity and leveling off of defense needs should ease the situation by late 1952, with controls relaxed or abandoned by 1953.

PRICES OF FOUNDRY METALS AND COKE

(As of June 25, 1951)

FOUNDRY COKE

(Per net ton, f.o.b. ovens)

BEEHIVE	
Connellsville	$17.00-18.00
New River	21.30
Wise County	15.95
OVEN	
Birmingham	$20.30
Chicago	23.00
Detroit	24.00
Erie, Pa.	23.50
Everett, Mass.	24.80
Indianapolis	22.75
Kearney, N. J.	22.75
Milwaukee	23.75
Painesville, O.	24.00
Philadelphia	22.70
Neville Island (Pittsburgh)	23.00
Portsmouth, O.	22.50
St. Louis	24.25
Swedeland, Pa.	22.00
Terre Haute, Ind.	22.50

PIG IRON

(Per gross ton, f.o.b. furnace)

	No. 2 Foundry	Malleable
Bethlehem, Pa.	$54.50	$55.00
Birmingham	48.88	....
Buffalo	52.50	53.00
Chicago	52.50	52.50
Cleveland	52.50	52.50
Everett, Mass.	53.25	53.75
Fontana, Calif.	58.50	....
Geneva, Utah	52.50	....
Granite City, Ill.	54.40	54.90
Lone Star, Tex.	48.50	48.50
Neville Island (Pittsburgh)	52.50	52.50
Steelton, Pa	54.50	55.00
Swedeland, Pa.	56.50	57.00
Toledo, O.	52.50	52.50
Troy, N. Y.	54.50	55.00
Youngstown, O.	52.50	52.50

NONFERROUS INGOTS

BRASS AND BRONZE: 85-5-5-5—29.00c; 88-10-2—44.50c: 80-10-10—35.00c; No. 1 yellow—25.50c. **ALUMINUM:** 99 per cent plus, primary ingots 19.00c. Secondary No. 12 alloy 30.75-31.50c. **MAGNESIUM:** 99.8 per cent standard ingots 24.50c, f.o.b. Freeport, Tex. **COPPER:** Electrolytic 24.50c, Connecticut valley; Lake 24.61½c, delivered. **ZINC:** High grade 18.85c, delivered.

IRON AND STEEL SCRAP

(Ceiling prices per gross ton as established by the Office of Price Stabilization)

	*No. 1 Heavy Melting Steel	**Steel, 2 ft & less	Punchings, Plate Scrap	Cast Iron Briquets
Birmingham	$39.00	$41.00	$41.50	$39.00
Buffalo	43.00	45.00	45.50	43.00
Chicago	42.50	44.50	45.00	42.50
Cincinnati	43.00	45.00	45.50	43.00
Cleveland	43.00	45.00	45.50	43.00
Detroit	41.15	43.15	43.65	41.15
Eastern Pa.	42.50	44.50	45.00	42.50
Los Angeles	35.00	37.00	37.50	35.00
Pittsburgh	44.00	46.00	46.50	44.00
San Francisco	35.00	37.00	37.50	35.00
St. Louis	41.00	43.00	43.50	41.00
Seattle	35.00	37.00	37.50	35.00

Above delivered prices are ceiling levels at basing points indicated. * Applies to dealer and industrial scrap; railroad heavy melting is $2 higher. ** Foundry steel 1 ft and under is $2 higher.

CAST IRON SCRAP

No. 1 cupola cast	$49.00
Heavy breakable cast	45.00
Burnt cast iron	41.00
Cast iron brake shoes	41.00
Stove plate	46.00
Clean auto cast	52.00
Unstripped motor blocks	43.00
Iron wheels, No. 1	47.00
Malleable	55.00
Drop broken machinery cast	52.00

Above ceiling prices, per gross ton, are f.o.b. shipping point. Add transportation charges to obtain delivered prices at any foundry.

DON'T BUY A PIG IN A POKE . . .

or sell one either

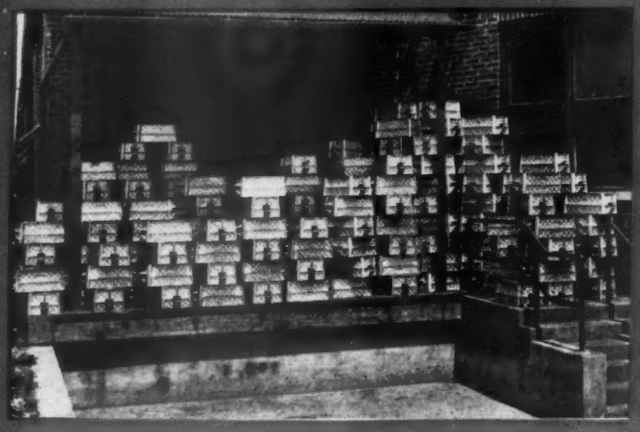
X-RAY

With the world's finest radiographic apparatus now available, why take chances on buying or selling imperfect castings. It's like a pig in a poke when you do, for only x-ray equipment can detect many hidden defects in castings.

Scores of companies now rely on General Electric X-Ray industrial units, such as the OX-250 shown here, for proof of sound castings. Job lot or production line, x-ray fits. Spot checking or 100% inspection, it can be adapted to your particular need. A pound of metal or a ton, there's a GE X-Ray unit to meet the need — dependably, economically, profitably.

Write for Pub. 11A-3116 "Radiography as a Foundry Tool." X-Ray Dept., General Electric Company, Milwaukee 14, Wisconsin, Rm. YY-7.

GENERAL ELECTRIC

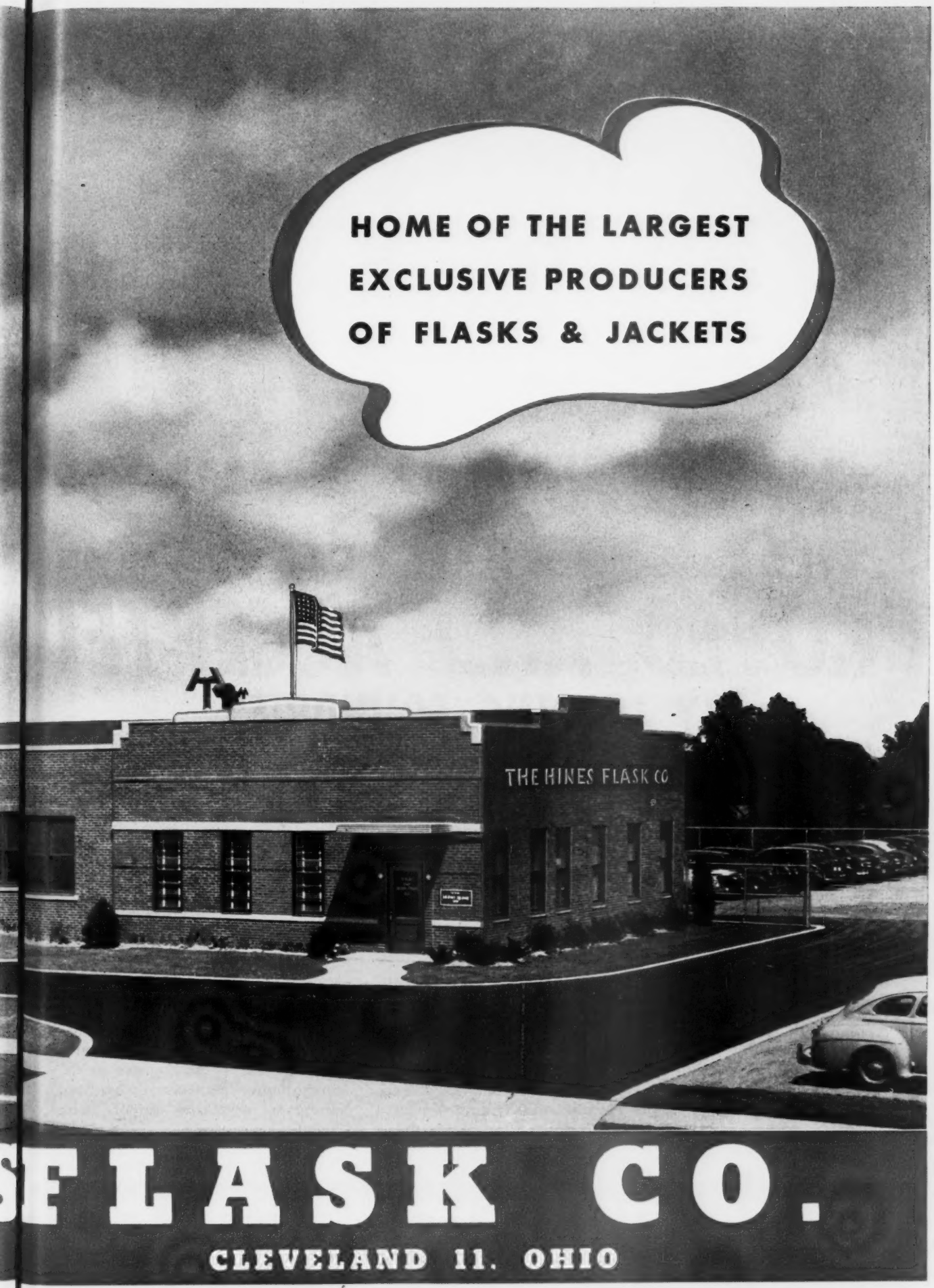


HINES' PRODUCTS

ALUMINUM "POP-OFF" FLASKS
ALUMINUM SLIP FLASKS
ALUMINUM TIGHT FLASKS
ALUMINUM JACKETS
CAST IRON JACKETS
ALUMINUM & ASBESTOS JACKETS
PINS AND BUSHINGS

THE HINES

3431 WEST 140th STREET


HOME OF THE LARGEST
EXCLUSIVE PRODUCERS
OF FLASKS & JACKETS
THE HINES FLASK CO
FLASK CO.
CLEVELAND 11. OHIO

Now.... DELTA

96·B SAND RELEASE AGENT

PREVENTS STICKING ...MAKES SAND FLOW FREELY

Another Foundry "First" by **DELTA**

HAS BEEN PROVED AND ACCEPTED BY LEADING FOUNDRIES

By adding only 8 ounces or less of DELTA 96·B SAND RELEASE AGENT, per ton, to your core or molding sand mixes, your sands will flow freely . . . be easier to handle . . . easier to use. They will not stick to core boxes or patterns no matter how intricate they may be.

DELTA 96·B SAND RELEASE AGENT is the result of persistent research by DELTA Laboratories devoted to the discovery and development of a lubricant-dispersant for use in sand mixes. DELTA 96·B is a liquid which provides properties hitherto unknown in sand conditioning materials. It is completely volatile at elevated temperatures and does not contaminate the sand.

Prove it yourself in your own foundry. Ask for a test sample. No cost or obligation. You will also receive instructions for use. Write today.

READ WHAT USERS SAY ABOUT DELTA 96·B SAND RELEASE AGENT

". . . . with the addition of 96·B we get improved core density and more uniformly-rammed mold hardness."

". . . . with the addition of 8 ozs. of Delta 96·B we are now able to blow cores we otherwise couldn't blow."

". . . . Delta 96·B gives the sand improved flowability. Our sand now works much more freely and leaves the core boxes clean."

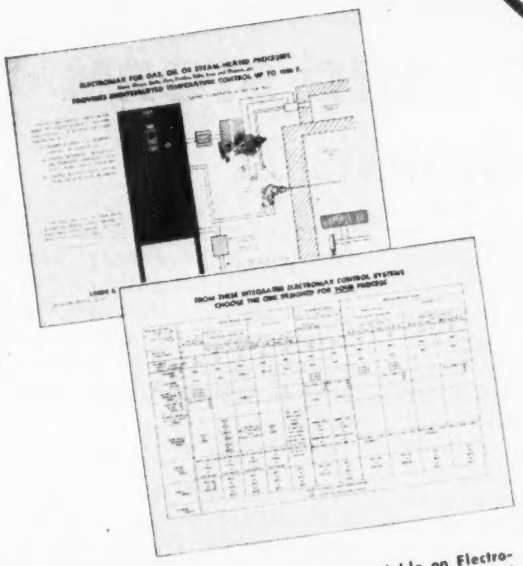
". . . . and the trouble we had with sand sticking in the hoppers, in the chutes and on the conveyor has been eliminated with the use of Delta 96·B."

DELTA OIL PRODUCTS CO.

MILWAUKEE 9, WISCONSIN

Dependable temperature control to 1000 F

Connection between the instrument and its primary element (a Thermohm temperature detector) is wire . . . not tubing. Can be any length without affecting accuracy or dependability.



Typical samples of the information available on Electromax Control. Specify nature of process and whether fuel is gas, oil, steam or electricity.

ELECTROMAX Controllers give modern electronic regulation to thousands of important manufacturing processes. In any application up to 1000 F they exactly fill the bill for non-recording controllers of outstanding dependability.

Electromax has the sensitivity, accuracy and dependability of its big brother Speedomax Recording Controller. Likewise, it is not affected by vibration or building tremors . . . can even be mounted on the frame of a molding press. The instrument needs almost no attention, because it has only one moving part . . . a covered plug-in type relay. There's usually no need to open the instrument door for months at a time.

Electromax Control is available to provide any one of three control actions. For the more simple process requirements, on-off or two position control is usually used. For processes requiring control within unusually close limits, two different types of proportional control are available . . . Position-Adjusting Type and Duration-Adjusting Type. All three types of control action can be applied to electric, steam or fuel heating.

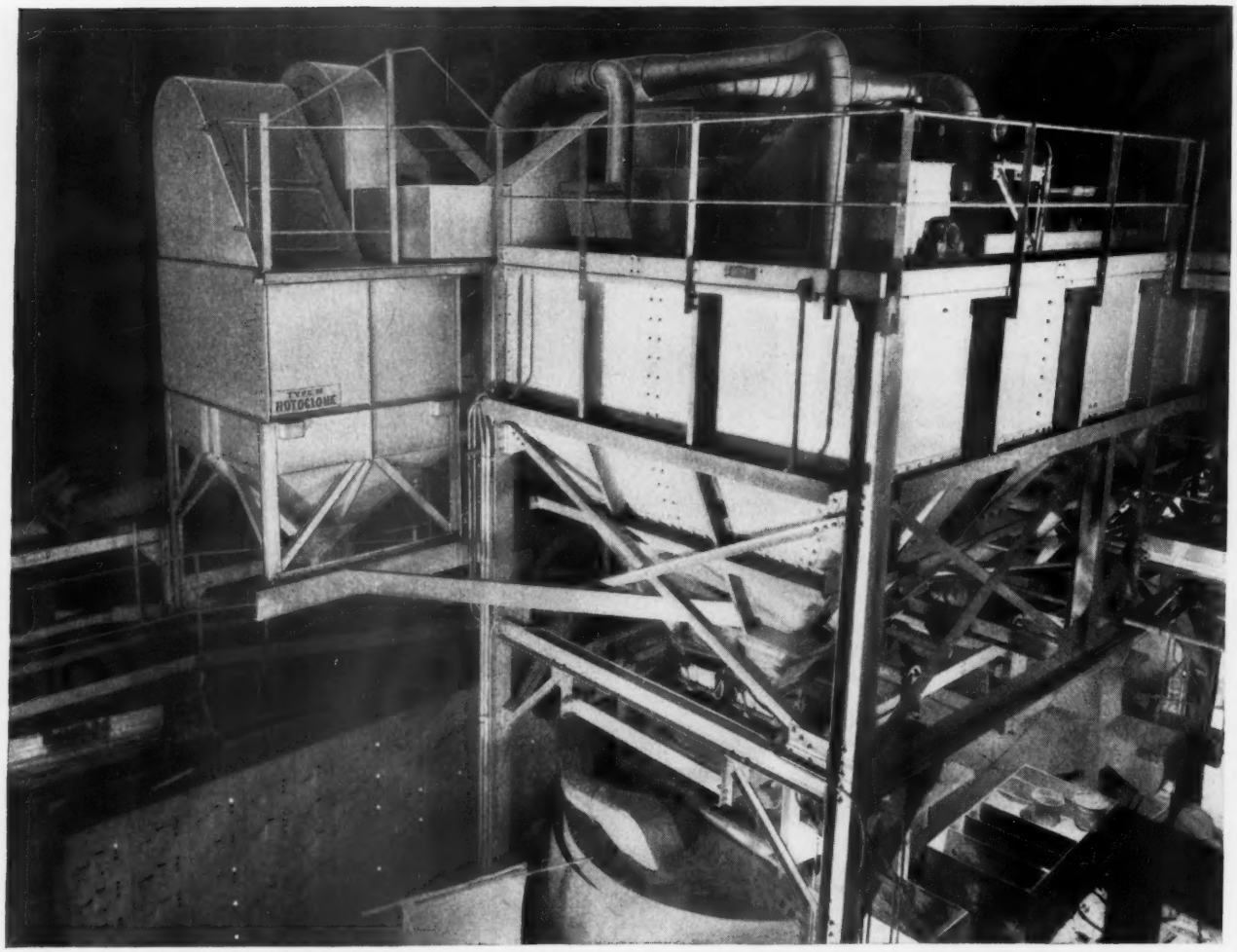
For further information, write our nearest office, or 4917 Stenton Ave., Phila. 44, Penna.

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

LEEDS & NORTHRUP CO.

Jrl Ad ND47(2)

clean air costs less than dust!



No. 12 Type-N Roto-Clone applied to mechanized sand conditioning system.

ROTO-CLONE SETTLES SAND STORM

now! clean air and clear vision

THIS sand conditioning system was once the source of a blinding dust storm. At times you could hardly see your hand—let alone a bolt head. An AAF Roto-Clone* installation settled the problem by collecting dust immediately from each source—screen, conveyor transfer point, shake-out hopper. Now, the air is *clean* . . . the Roto-Clone provides clear vision, better working conditions and improved efficiency.

An interesting feature of the No. 12 Type-N Roto-Clone shown above is the overhead mounting. This installation reduces costly pipe-runs and conserves floor space. The Type-N is a hydro-static precipitator of high efficiency, which removes dust by dual washing and scrubbing action. It has no moving parts and combines in one unit the three functions of exhausting, separating and storing dust . . . in the form of sludge. The Type-N also provides continuous operation at peak efficiency without interruption for reconditioning.

The complete line of AAF Roto-Clones offers a wide selection of performance and operating characteristics that will efficiently control every dust source. For the correct solution to your dust or air pollution problem call your nearby AAF representative or write direct to American Air Filter Company.

* * *

**ROTO-CLONE is the trade-mark (Reg. U. S. Pat. Off.) of the American Air Filter Company, Inc., for various dust collectors of the dynamic precipitator and hydro-static precipitator types.*

AAF **American Air Filter**
COMPANY, INC.
266 Central Avenue, Louisville 8, Kentucky • In Canada: Darling Bros., Ltd., Montreal, P. Q.

Foundry Coke AVAILABLE

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Producers of [FOUNDRY / METALLURGICAL / INDUSTRIAL] *Coke*

- *Hard Structure*
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Phone: New Haven 4-1681

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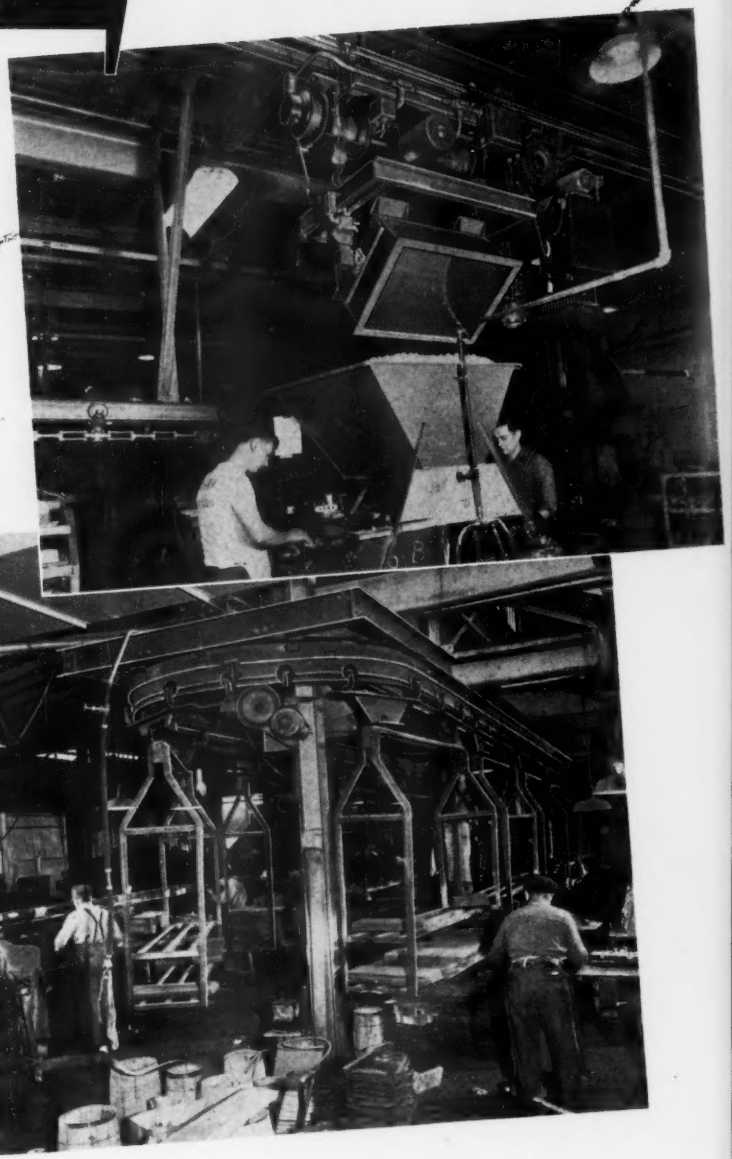
INCREASE PRODUCTION NOW...

WITH

Present Plant Manpower

Present Plant Space

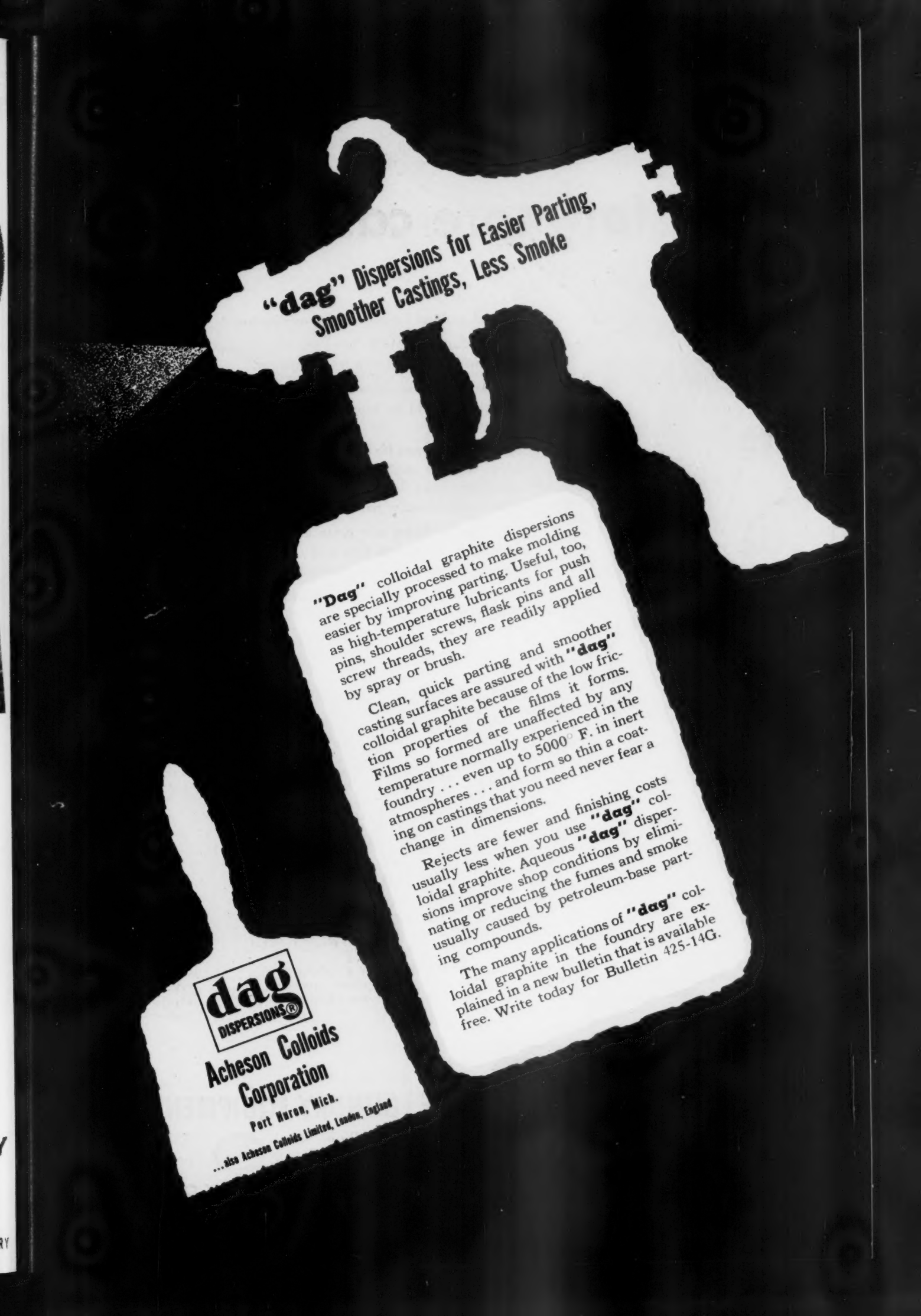


The next time you walk through your plant, cast your eyes toward the ceiling and you'll realize that there is mighty valuable space that can be put to work—without increasing your plant capacities and without increasing plant manpower.

An American MonoRail engineer will show you how you can use your "air rights". With thousands of overhead handling installations from which to draw, each with many money and time saving advantages, it will pay you to investigate American MonoRail Overhead Handling Systems. Send for bulletin C-1.

THE AMERICAN MONORAIL COMPANY

13104 ATHENS AVENUE **CLEVELAND 7, OHIO**


"dag" Dispersions for Easier Parting, Smoother Castings, Less Smoke
"Dag" colloidal graphite dispersions are specially processed to make molding easier by improving parting. Useful, too, as high-temperature lubricants for push pins, shoulder screws, flask pins and all screw threads, they are readily applied by spray or brush.
Clean, quick parting and smoother casting surfaces are assured with "dag" colloidal graphite because of the low friction properties of the films it forms. Films so formed are unaffected by any temperature normally experienced in the foundry . . . even up to 5000° F. in inert atmospheres . . . and form so thin a coating on castings that you need never fear a change in dimensions.
Rejects are fewer and finishing costs usually less when you use "dag" colloidal graphite. Aqueous "dag" dispersions improve shop conditions by eliminating or reducing the fumes and smoke usually caused by petroleum-base parting compounds.
The many applications of "dag" colloidal graphite in the foundry are explained in a new bulletin that is available free. Write today for Bulletin 425-14G.
dag DISPERSIONS®
Acheson Colloids Corporation
Port Huron, Mich.
...also Acheson Colloids Limited, London, England

for more castings of high

The need is critical for more, better quality, true-to-pattern castings.

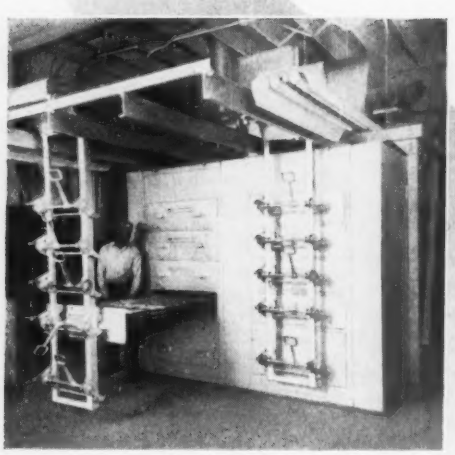
Coleman Core and Mold Ovens are vital in helping you meet this need better, faster and with less manpower.

Coleman Core Ovens produce perfectly baked cores, eliminate losses and delays caused by improper handling methods and inefficient oven equipment.

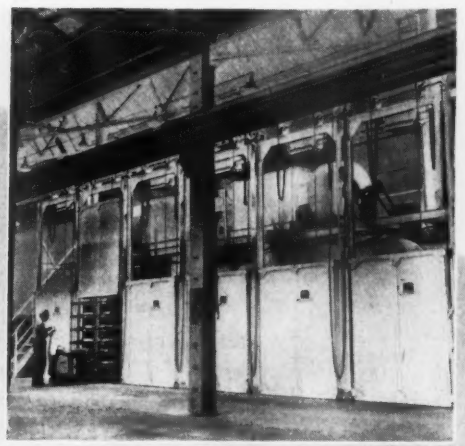
Coleman Mold Ovens for dry sand molding insure the proper drying needed to make castings always true-to-pattern. Coleman Ovens handle all types of molds uniformly and dependably, whether molds are to be skin dried or bone dried.

Today you are faced with acute labor shortages, high fuel costs, and scarcity of materials. That is why Coleman Ovens are more than ever essential to meet your requirements for increased production.

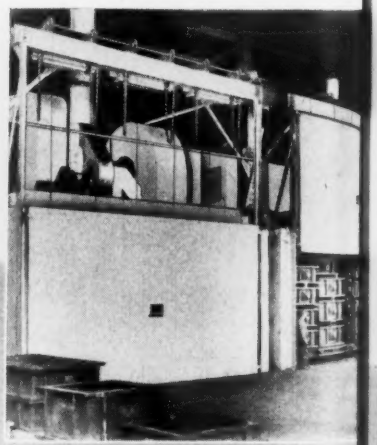
There is a type of Coleman Oven to help give you maximum production on every core baking or mold drying job. Write for Bulletin 48.



COLEMAN ROLLING DRAWER OVENS For small and medium cores. High-speed production with limited floor space.



COLEMAN TRANSRACK OVENS For use with portable racks to reduce handling labor. Very efficient where ample floor space is available.



COLEMAN CAR-TYPE OVENS For bak large cores or drying molds. Colem Car-Type Ovens are used by most the leading producers of heavy castin

A COMPLETE RANGE OF TYPES: COLEMAN OVENS are built in a complete range of sizes and capacities for every core-baking and mold drying requirement: Tower Ovens, Horizontal Conveyor Ovens, Car-Type Ovens, Transrack Ovens, Rolling Drawer Ovens, Portable Core Ovens, Portable Mold Dryers, etc.

THE FOUNDRY EQUIPMENT COMPANY

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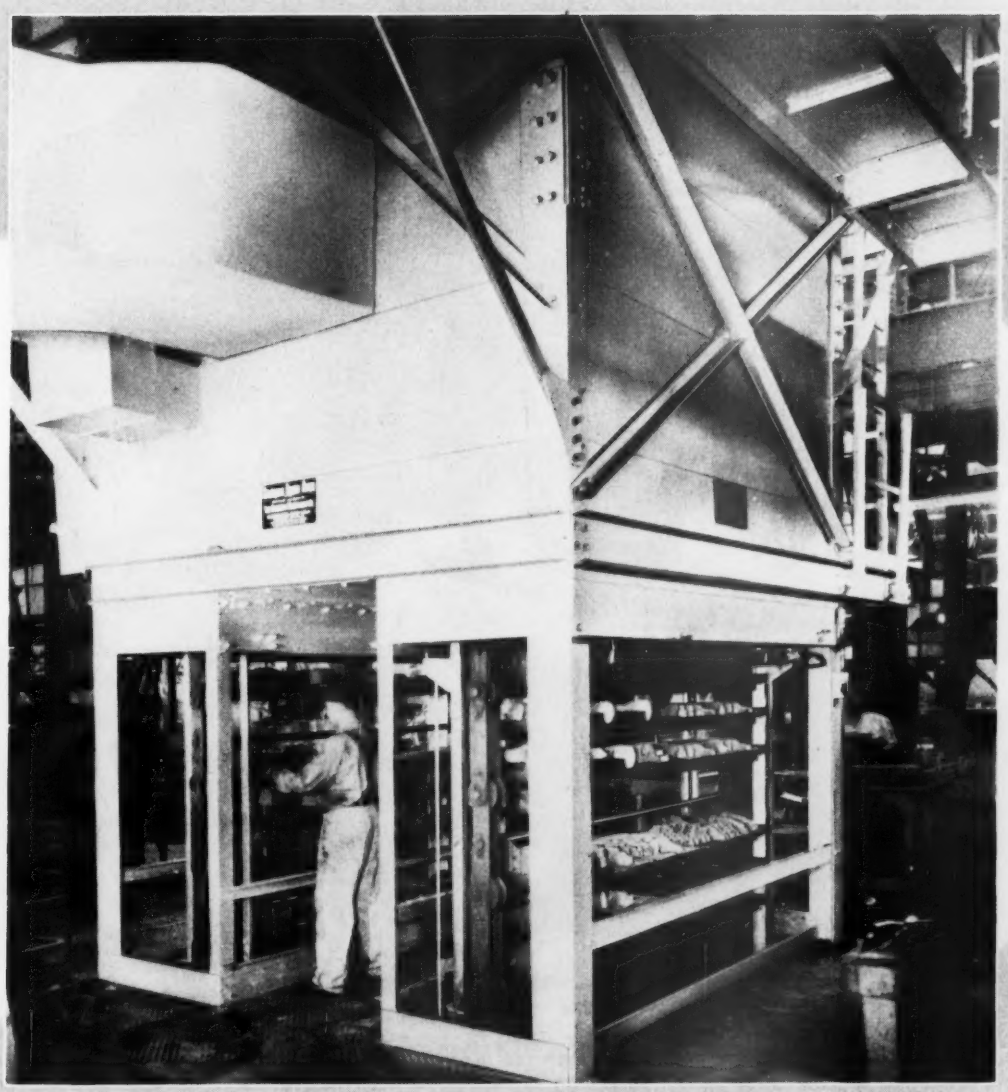
WORLD'S OLDEST AND LARGEST FOUNDRY OVEN SPECIALISTS

COLEMAN OVENS

equality, with less manpower . . .



COLEMAN TOWER OVENS For high speed production at lowest cost. Patented Open Center permits loading from inside and out, providing maximum labor saving.

ONLY COLEMAN OVENS OFFER ALL THESE ADVANTAGES

GREATEST SAVINGS IN MAN-POWER resulting from methods which reduce handling and indirect labor to a minimum.

INCREASED PRODUCTION by making the most efficient use of skilled and unskilled labor.

PERFECT BAKING eliminates manpower and casting losses due to make-overs and rejects.

GREATEST SAVINGS IN FUEL by using the most economical fuel available.

MOST ECONOMICAL BINDERS for your particular casting requirements—oil or resin—can be used.

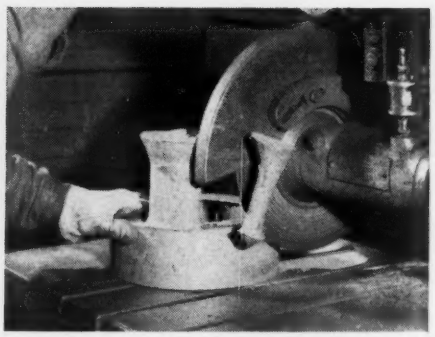
LOWEST MAINTENANCE COST for up-keep and service.

Long Lasting, Fast Cutting
Cost Cutting Performance
On Every Rough Grinding Job!

DOUBLING UP ON EFFICIENCY . . . With Norton wheels on both ends of your floor or bench stand, you're twice as sure of top performance. Norton has the right combination of abrasive and bond to produce the most satisfactory results on all types of off-hand grinding.

ECONOMY THAT GOES PLACES . . . Keeping pace with the rapidly growing use of portable grinding machines, Norton makes wheels of every type and size for portable applications, from snagging rough castings — as shown — to working intricate dies. For general rough grinding, Norton ALUNDUM* or CRYSTOLON* wheels provide fast cutting action and long service life.

TOPS FOR SAFETY . . . For speed in removing gates and risers from non-ferrous castings, use NORFLEX* reinforced resinoid cut-off wheels. They are equally effective for light snagging and slotting. The sturdy, flexible fabric structure withstands side-grinding, twisting, and bending without breakage.

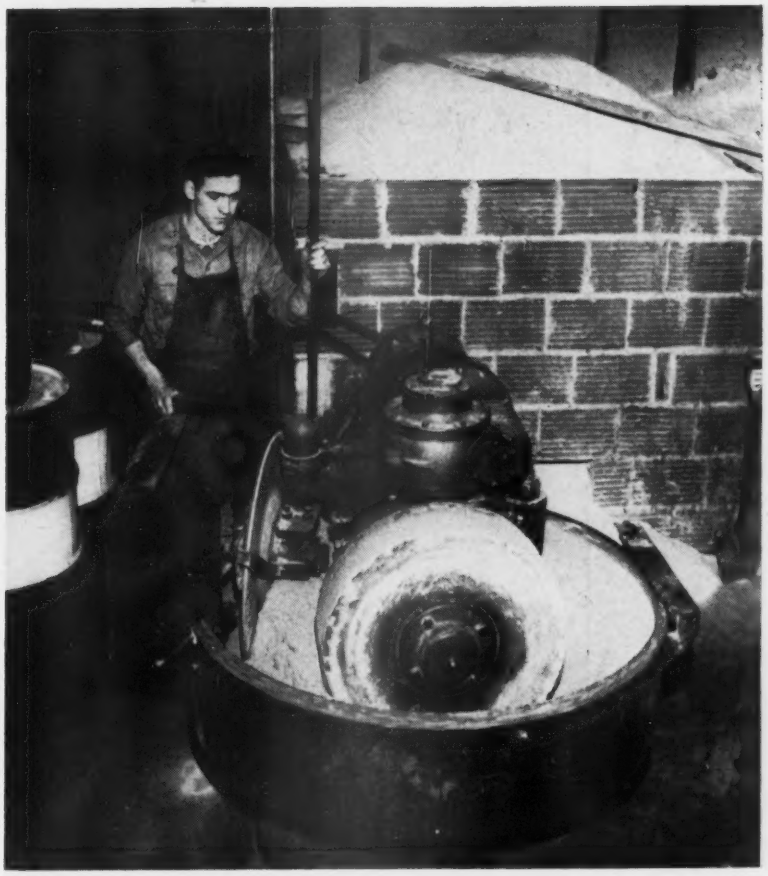


ALL AROUND THE SHOP . . . Never before have so many users done so many jobs with a single wheel! Norton *Reinforced* Hub Wheels will rough or finish the surface, notch risers on ferrous castings, cut down and smooth up weld beads and do many other jobs. And their strong fabric reinforcement means 2 to 5 times longer wheel life.

GET THE RIGHT WHEEL! That's the key to fast, economical grinding. And for every rough grinding job you do — from lightest burr-removal to heavy swing-frame work — there's a Norton wheel that's *exactly right*. And remember, your Norton distributor and Norton abrasive engineer are always ready to study your grinding applications. You'll find their suggestions point the way to sure savings in time and money. Meanwhile, you'll find a lot of facts about better, lower-cost rough grinding in the Norton booklet FORM 1405. Get it from your Norton distributor or representative, or write us direct. NORTON COMPANY, Worcester 6, Mass. Distributors in all principal cities.

NORTON
ABRASIVES
Making better products to make other products better

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries



This No. 404 Clearfield Mixer has been in operation for eight years in the core shop of the Railway and Industrial Engineering Co. of Greensburg, Pa., makers of electrical switchgear for substations and generating stations. During that time it has required only very few minor repairs and "has paid for itself many times over."

in preparation of foundry sand

The CLEARFIELD mixer

"Pays For Itself Many Times Over"

By its speed, its dependability, its flexibility—by the high quality sand it turns out—the Clearfield Mixer cuts costs and speeds production. In the unsolicited words of one of our satisfied customers "it pays for itself many times over."

Clearfield Mixers, featuring the famous revolving pan principle, are available in a wide range of sizes. There is a Clearfield Mixer to meet any sand preparation requirement you have, either as a single process or part of an integrated system.

Write today for Catalog No. 79
for complete details.

CLEARFIELD
MIXER

**MIXES, TEMPERS
AERATES**

CLEARFIELD
MACHINE COMPANY

CLEARFIELD
PENNSYLVANIA, U. S. A.

• • • • Pouring production! Production of all the things we need in our daily lives... and the things we require to preserve our freedom. The contribution of steel to our economy and our security is unmatched by any other industry.

Only with the help of the refractory industry could steel have achieved its fabulous progress. Only with the development of better and more diversified refractories and adequate production could steel deliver today's tonnage.

In the rapid growth of steel, General

Ladle of Liberty

GENERAL REFRACTORIES

GENERAL REFRACTORIES COMPANY
PHILADELPHIA

Refractories has played an important part. Wherever you go in the steel plant you'll find General products. Fireclay brick... silica brick... basic brick... including the famous STEELKLAD. You'll find, too, plastics and castables and bulk products of every description.

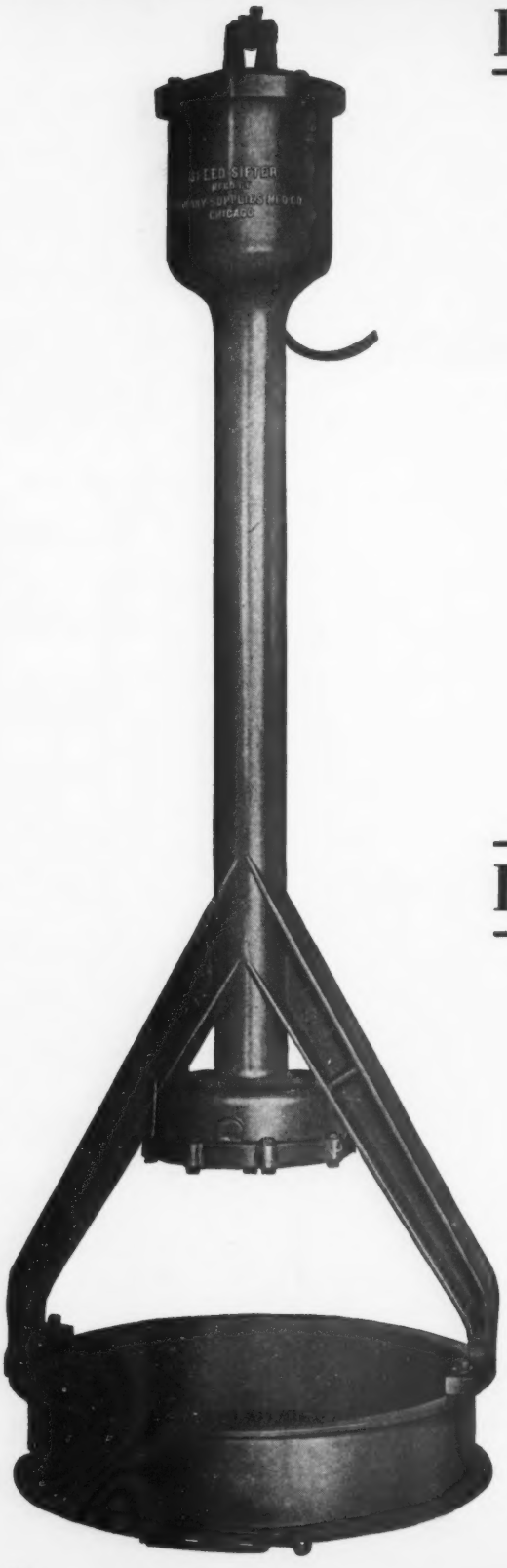
But General offers more than variety. It offers modern research facilities and production methods. It offers 43 mines, 29 plants, 18 sales offices and 200 distributing agencies, here and abroad. General really offers you a complete refractories service!

A Complete Refractories Service

Increase Production

with the

ROTOPLANE SPEED SIFTER ★ RED ELECTRIC VIBRATORS



ROTOPLANE SPEED SIFTER

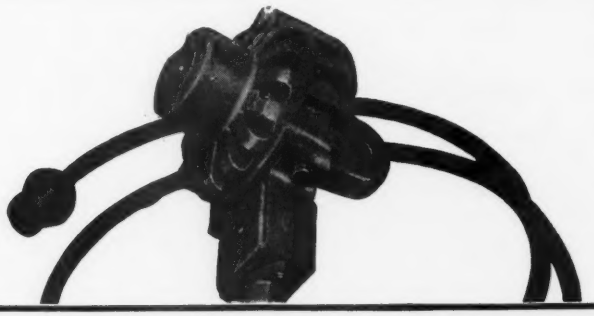
The ROTOPLANE Speed Sifter is an *improved* sand riddle of much greater capacity and much longer life. One size and type serves all purposes in the foundry—does *all* your sifting more quickly and economically.

It is easily handled by one man, weighs approx. 90 lbs. is 62 in. high overall. The one-piece frame of tough aluminum alloy makes for a remarkably effective vibration. Its smooth, free, rotary action vastly increases bearing life; all bearings grease packed. All mechanism of the ROTOPLANE is *completely* enclosed—no bearings or activating parts of any kind exposed to dust and grit.

The Quick-Change Sieves are instantly interchangeable, mounted in smooth, flat steel ferrule, with 20-inch diameter clear sifting area. No jagged edges to tear workers' hands, no storage problem.

$270.00 f.o.b. Chicago—complete with cable, safety ground wire. Standard 1/3 h.p. motor, 110 volt, 60 cycle, single phase and 220 volt, 3 phase motors $25.00 additional.

UNIVERSAL FREE - WHEELING RIDDLE equipped with motor as above $245.00



RED ELECTRIC VIBRATORS

True-to-pattern castings make satisfied customers . . . more repeat business. Increase your production and castings quality with RED Electric Vibrators. Sturdy, dustproof, lowest operating cost (electricity does not freeze). Unequaled for consistent year-'round results in foundries all over the world.

(All Prices f.o.b. Chicago)

No. 1—Light match plate work	$11.00
No. 2—Medium match plate work	13.00
No. 5—Heavy match plate, tub and bench work	17.00
No. 9—Machine and heavier work	26.80

Third (ground) wire per U. S. Govt. code—furnished with No. 9 at no extra cost; $1.20 extra with Nos. 1, 2 and 5 vibrators.

KNEE SWITCHES for operating Red Electric Vibrators:
Single pole $5.00, Double pole $6.50.

FOUNDRY SUPPLIES MANUFACTURING CO.

2221 Orchard Street **Chicago, Illinois**

CABLE ADDRESS: "ROTOPLANE CHICAGO"

A COMPLETE LINE MAKES SELECTION OF THE RIGHT TOOL EASY!
Thor
PORTABLE POWER
FOUNDRY
TOOLS
NDEPENDENT PNEUMATIC TOOL COMPANY • AURORA, ILLINOIS
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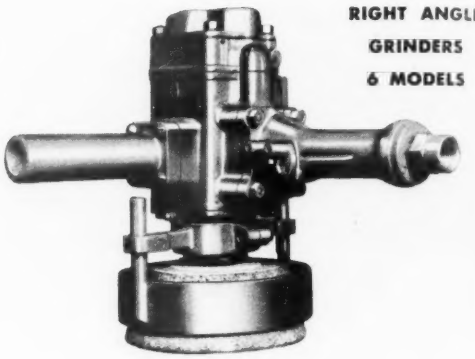
GRINDING

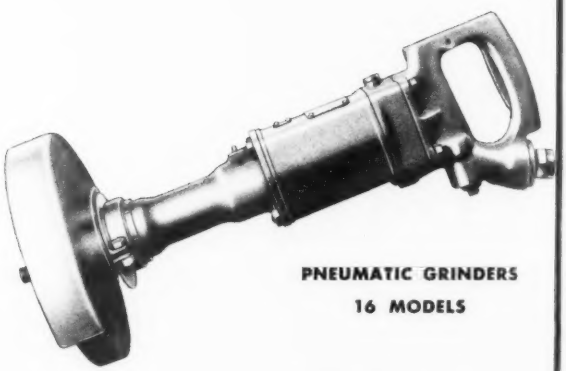
PNEUMATIC AND HIGH FREQUENCY ELECTRIC
180 and 360 CYCLE

HIGH FREQUENCY
ELECTRIC
GRINDERS
180 and 360
CYCLE
22 MODELS

HIGH FREQUENCY ELECTRIC
RIGHT ANGLE GRINDERS
180 and 360 CYCLE
22 MODELS

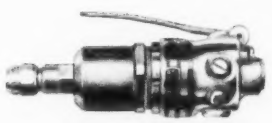
PNEUMATIC
RIGHT ANGLE
GRINDERS
6 MODELS





PNEUMATIC GRINDERS
16 MODELS

Thor PORTABLE POWER TOOLS

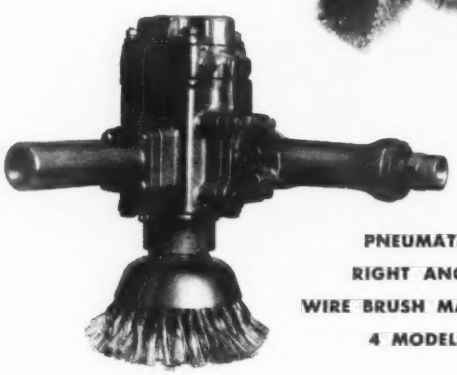


PNEUMATIC AND HIGH FREQUENCY
DIE GRINDERS
11 MODELS

HIGH FREQUENCY ELECTRIC
WIRE BRUSH MACHINES
180 and 360
CYCLE

7 MODELS

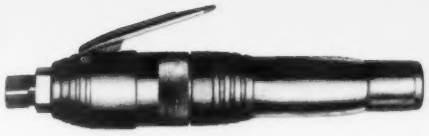
PNEUMATIC
WIRE BRUSH MACHINES
4 MODELS



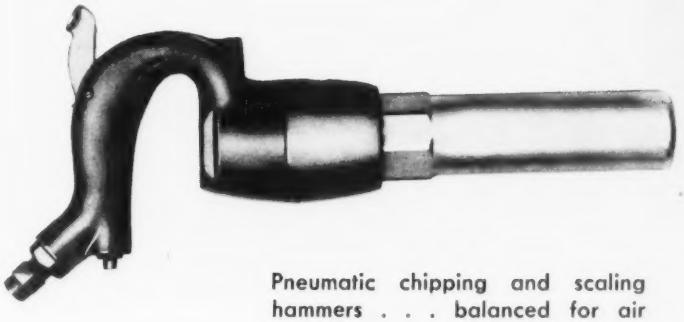
PNEUMATIC
RIGHT ANGLE
WIRE BRUSH MACHINES
4 MODELS

WIRE BRUSHING

PNEUMATIC AND HIGH FREQUENCY ELECTRIC
180 and 360 CYCLE

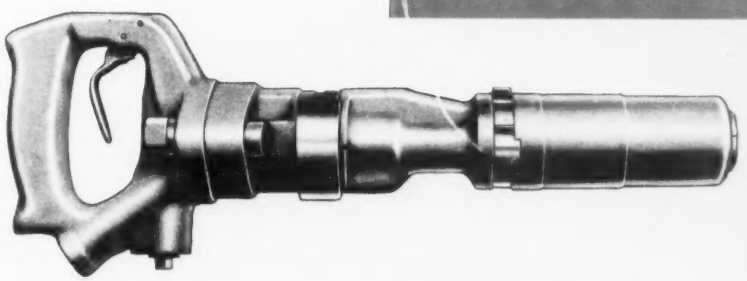


CHIPPING



Pneumatic chipping and scaling hammers . . . balanced for air economy, power and handling ease . . . 16 models.

CORE BUSTING

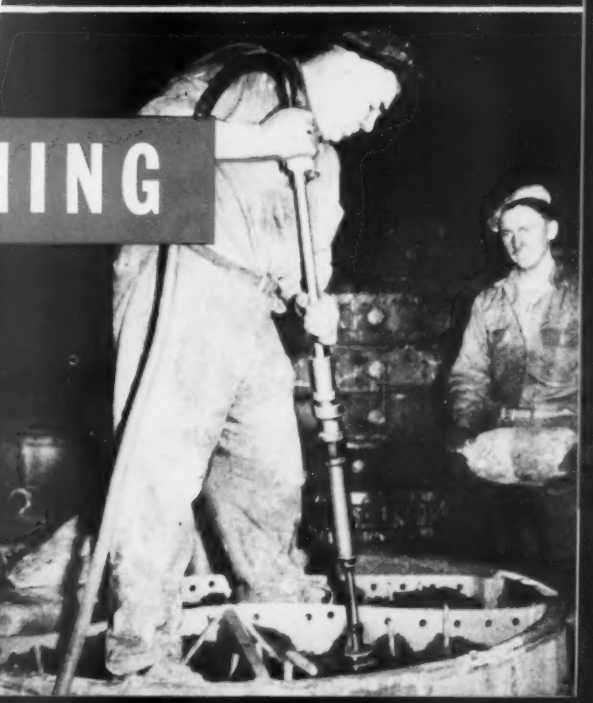


Famous Thor "413" pneumatic core buster for heavy duty work.

Perform in any position, even upside down!

RAMMING

Pneumatic floor and bench rammers . . . powerful stroke, easy to guide. 4 models.



HOISTS

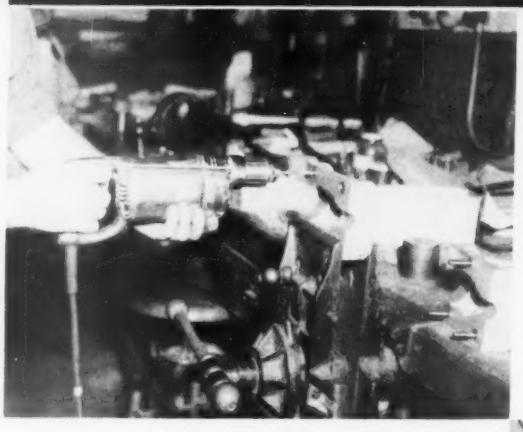
Safe, air-powered machines for raising or removing work or equipment. 11 models for loads from 500 to 6000 pounds.

BALANCERS

Suspend grinders and other tools over the work for greater efficiency. 36 models for all loads from 0 to 300 pounds.

Thor PORTABLE POWER TOOLS

FOR THE PATTERN SHOP



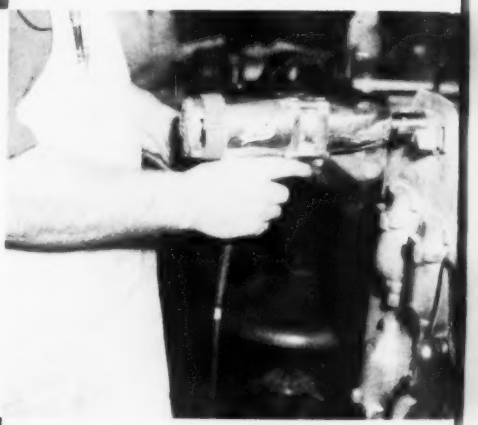
DRILLS

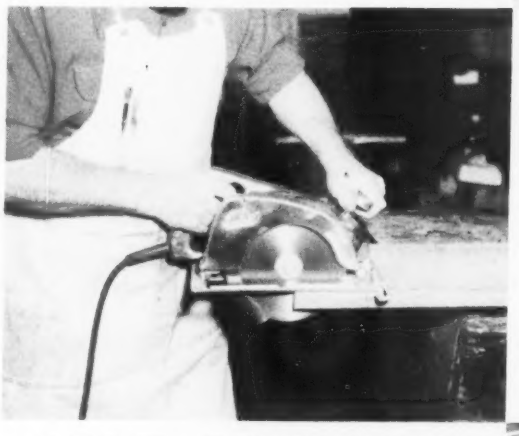
171 Models

1/8" to 4" Capacity

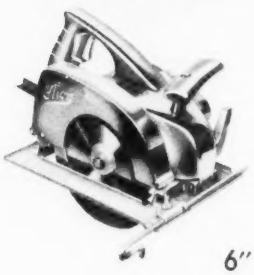
IMPACT WRENCHES

1/4" to 1 1/4" Capacity





SAWS

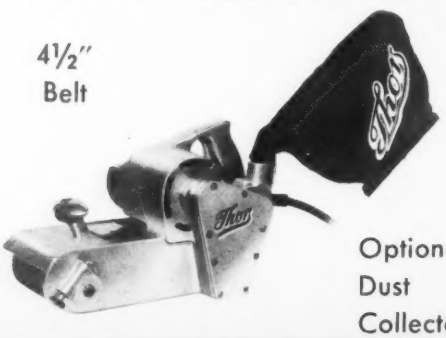


6 Models

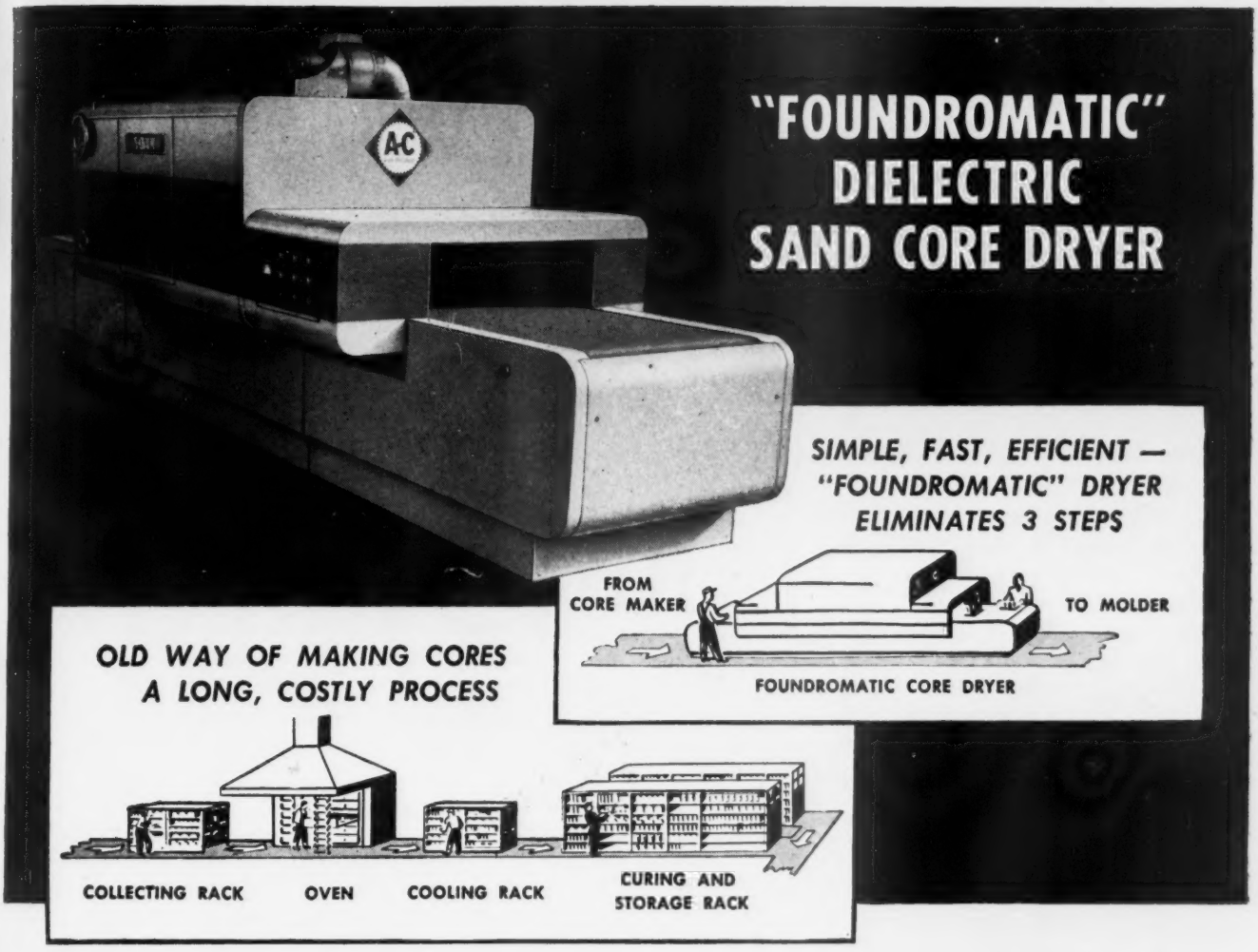
6" to 12" Blade

BELT SANDERS

4 1/2" Belt



Optional Dust Collector



NOW CORE MAKING TIME CAN BE CUT

...from Days to Minutes!

YOU ELIMINATE these three costly steps from core making by using the *Foundromatic* Sand Core Dryer:

1. Eliminate collecting racks. Cores are placed by the coremaker directly onto the moving conveyor belt of the *Foundromatic* Sand Core Dryer.
2. Eliminate cooling racks. When cores come out of dryer, they're cool, dry, ready-to-use.
3. Eliminate curing and storage racks. Cores can be made as needed in a matter of minutes without building up stocks for the next day or week.

In addition there are big fuel savings of 30% to 80% . . . Overbaking of cores is impossible . . . Burning of fins or thin section is ended . . . Working conditions are improved too, because fumes and heat are eliminated from the core room.

Any core that will pass through an aperture 36 inches wide and 13 inches high can be dried in the *Foundromatic* Sand Core Dryer. For details, call your nearby Allis-Chalmers Sales Office.

Foundromatic is an Allis-Chalmers trademark.

ALLIS-CHALMERS

Allis-Chalmers
Milwaukee 1, Wis.

Please send information on the *Foundromatic* Sand Core Dryer.

Name .....

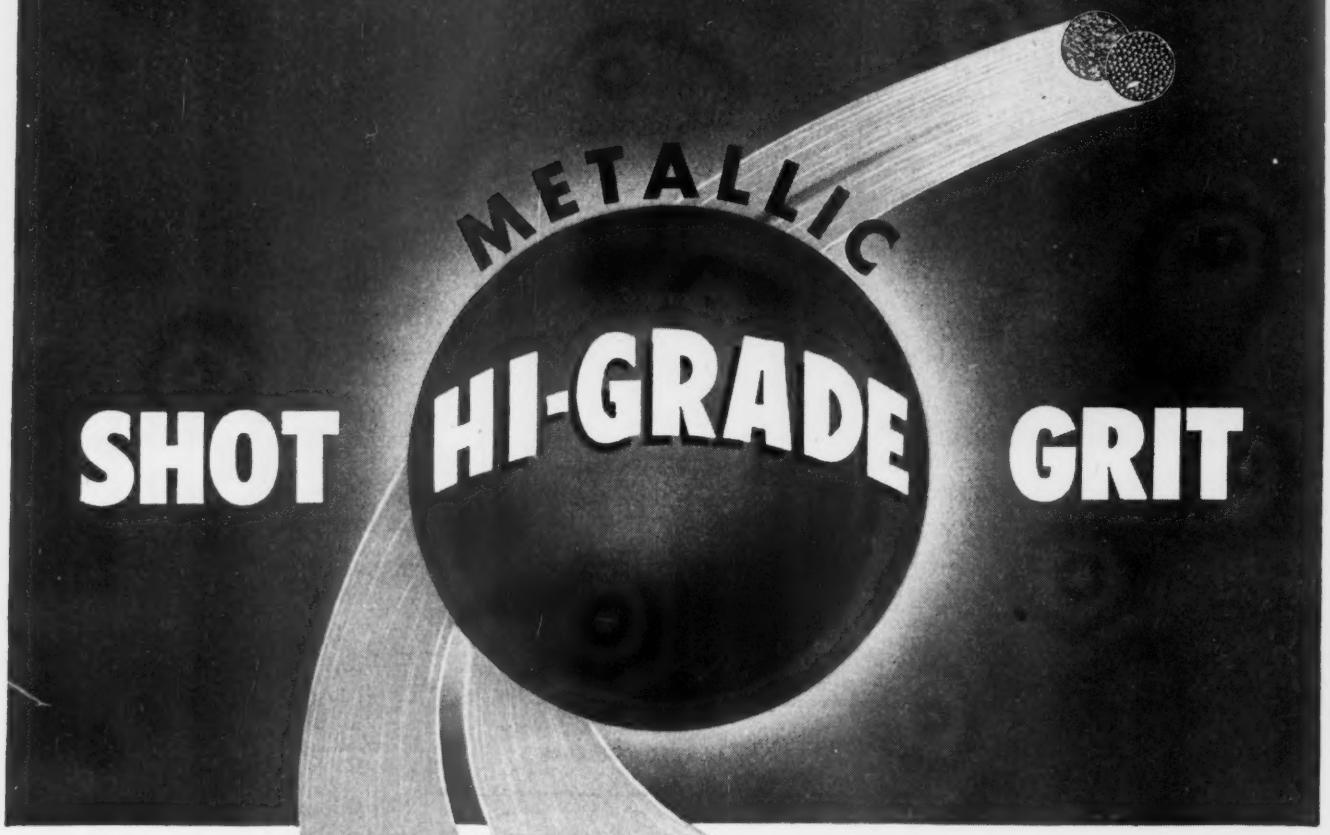
Title .....

Company .....

City ..... State .....

A-3246

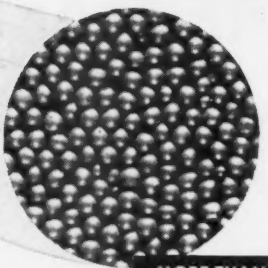
For Uniform, Low Cost, Efficient Blast Cleaning



When you buy shot and grit, you buy a promise of uniform, low cost, efficient blast cleaning or peening. Your confidence in the material ordered should be based on actual use, rather than recommendation or reputation. Its true value to you can only be determined by a thorough test in your equipment, on your job.

To all outward appearances, most shot and grit may appear to be the same—but, that's where the similarity ends. Where Hi-Grade Shot and Grit are concerned, you'll find there IS a difference . . . a value far beyond purchase price that pays out in extra performance on *your* job. Hi-Grade Shot and Grit is *quality-controlled* from molten metal to finished product. Order a trial quantity today. Let results convince you *Hi-Grade is best by test.* That's the only practical and profitable way to buy abrasives.

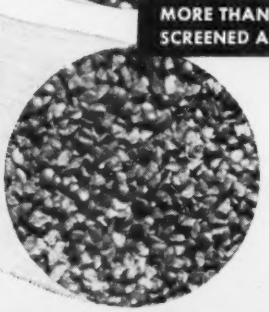
PACKED IN 100 LB. BAGS
READY FOR IMMEDIATE SHIPMENT



HI-GRADE SHOT
UNIFORM SIZE AND HARDNESS

Withstands repeated strain, stress and wear. Famous for its lack of hollows, tails, irregular shapes. Exclusive alloying and tempering process helps prevent rust; minimizes impact fractures.

MORE THAN MEETS S.A.E. SPECIFICATIONS
SCREENED AND GRADED FOR 100% USAGE



HI-GRADE GRIT
SHARP, TOUGH AND DURABLE

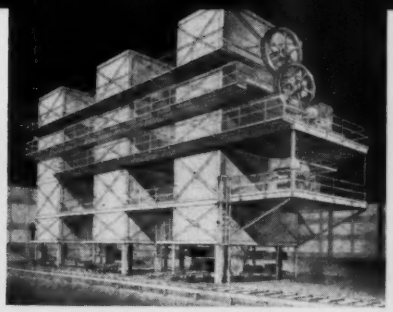
Made of same material and processed by same methods as Hi-Grade Shot. Free from dust fines and scale. Cleans with maximum efficiency. Easy on equipment—reduces wear and maintenance costs.

Clayton-Sherman *Abrasives Company*

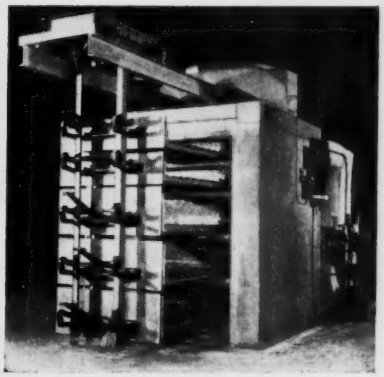
MANUFACTURERS OF *QUALITY-CONTROLLED* SHOT AND GRIT

Representatives in Principal Cities

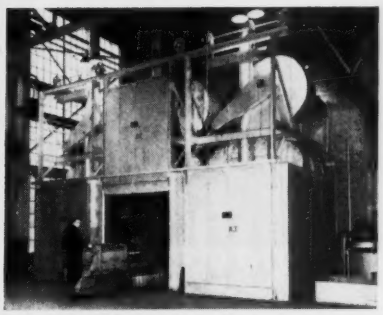
3896 LONYO ROAD ★ DETROIT 10, MICHIGAN



VERTICAL CORE OVENS
at General Steel Castings Co.



ROLLING DRAWER CORE OVEN
at Aluminum Co. of Ameriaa



RACK TYPE CORE OVENS
at Aluminum Co. of America

CARL-MAYER
CORE AND MOLD OVENS

Outstanding Engineering

ALSO OTHER TYPES OF INDUSTRIAL OVENS, AND FURNACES.

OUR CUSTOMERS

Important concerns like these:

Aluminum Co. of America
American Brake Shoe Co.
American Radiator Co.
Blaw-Knox Co.
Brown Industries
Buick Motor Div. of General Motors Corp.
Bucyrus-Erie Co.
Cadillac Motor Div. of General Motors Corp.
Columbia Steel Corp. (U.S. Steel Corp.)
Crucible Steel Castings Co.
Dunkirk Radiator Co.
Eclipse Aviation Division of Bendix Aviation Corp.
Electric Autolite Co.
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Gilbert & Barker Co.
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Mesta Machine Co.
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Oil Well Supply Co. (U. S. Steel Corp.)
Packard Motor Car Co.
H. B. Salter Co.
Shenango Penn Mold Co.
Standard Foundry Co.
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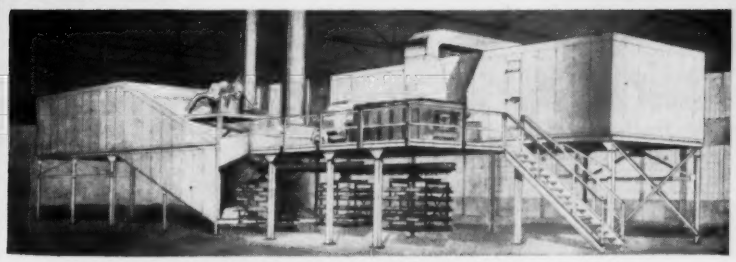
West Steel Castings Co.
A. C. Williams Co.
Whiten Machine Works
Whiting Corp.

CAR TYPE MOLD OVEN
at Oil Well Supply Co.



HORIZONTAL MONORAIL CORE OVEN at Eclipse Aviation Co.

Write for Bulletins No.141 and 350

THE CARL-MAYER CORPORATION

3030 Euclid Avenue • Cleveland, Ohio

BACKED BY REPUTATION AND OVER 30 YEARS' EXPERIENCE

MORE MINUTES IN YOUR MAN-HOURS!

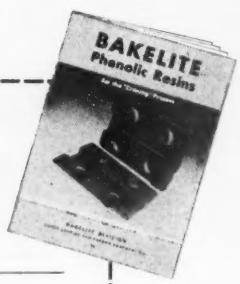
The Croning Process for making thin-shell sand molds and cores bonded with BAKELITE Phenolic Resins, can add more minutes to your present man-hours. Greater production efficiency means that you can turn out castings faster, better, at lower cost, and with fewer rejects. These advantages are particularly important when manpower and materials are limited, as at present.

Castings made by the Croning Process have pattern-smooth surfaces. The process permits the use of finer sands so that smoothness is obtained along with the necessary porosity for the escapement of gases.

Other advantages of the "C" Process worthy of your careful comparison with usual sandbox methods are:

- Molds and cores are of uniform quality, reducing rejects of castings.
- You use 90 per cent less sand.
- Molds and cores are rapidly made; are strong, moisture-resistant, stable; can be stored for long periods.
- Floor space is used more efficiently.

We'll gladly send you more information on how to save production time, conserve essential ferrous and nonferrous metals, and lower foundry costs, with BAKELITE Phenolic Resins for the "C" Process. Use the coupon below.



Dept. CG-29, BAKELITE COMPANY,
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

Please mail at once my free copy of the booklet, "BAKELITE Phenolic Resins for the Croning Process."

*Name*_____ *Title*_____

*Company*_____

*Street*_____

*City*_____ *State*_____

BAKELITE
TRADE-MARK
PHENOLIC
BONDING RESINS
TRADE MARK

BAKELITE COMPANY
A Division of
Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

SHAKEOUT IN SECONDS! KNOCKOUT IN MINUTES!

—THAT'S THE STORY AT STANDARD FOUNDRY CO. WITH FLOATEX®

Imagine! An 8000 lb. flask shaken out in seconds! The outside cores of that 3500 lb. casting knocked out in minutes!

That's the result at the Standard Foundry Co. plant in Worcester, Mass., with two Hewitt-Robins Floatex Shakeouts!

Standard Foundry needed two Floatex Shakeouts to keep up with high-speed production demands. But other foundries—hundreds of them throughout the world—are doing both flask shakeout and core knockout work on a *single* Floatex unit.

This versatile machine—with its genuinely full-floating principle that shakes the flask, not the foundry—can be equipped with a special cast-steel deck well able to withstand the punishing impact of core knockout work *in addition* to shaking-out flasks. One machine . . . one investment.

—and lowest imaginable maintenance cost! No Floatex cast-steel deck has ever worn out; no Floatex bearing or shaft has ever been broken —for none of the weight (of the machine or the superimposed load) is carried on bearing or shaft.

Hewitt-Robins Floatex Shakeouts are made in portable, stationary and mechanical self-discharging types—in sizes for castings weighing a few ounces to flasks weighing 100 tons or more. For all the interesting details, write for Bulletin 124-B, Robins Conveyors Division, 270 Passaic Avenue, Passaic, N. J.

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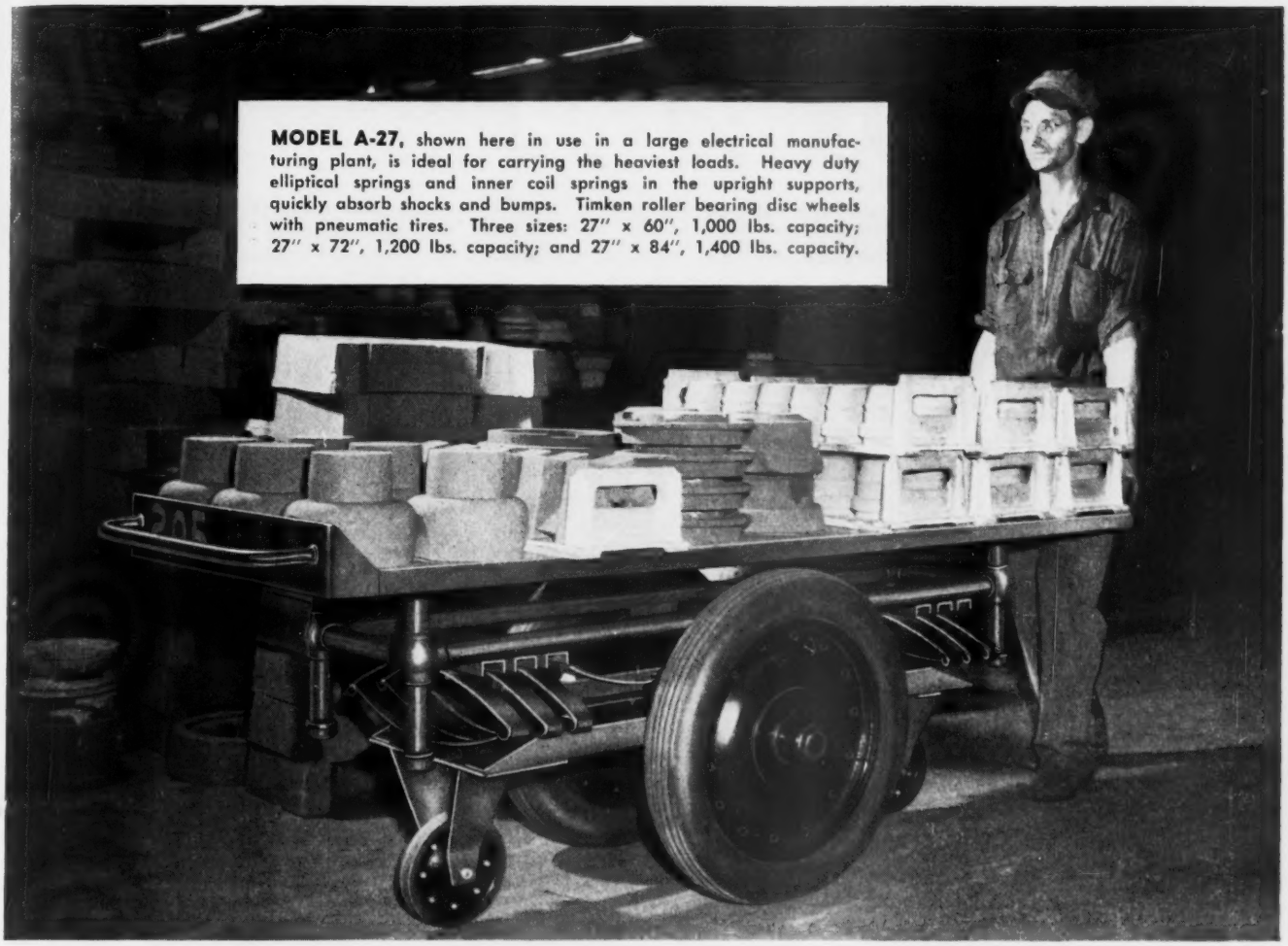

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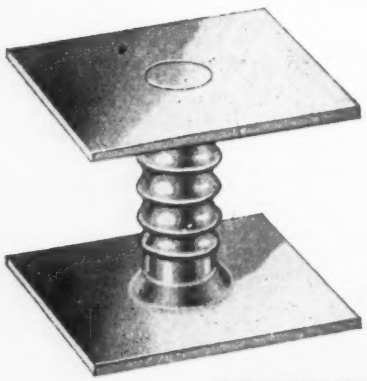

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Sharp, right angle shoulders of conventional type of chaplet form large gas pockets.

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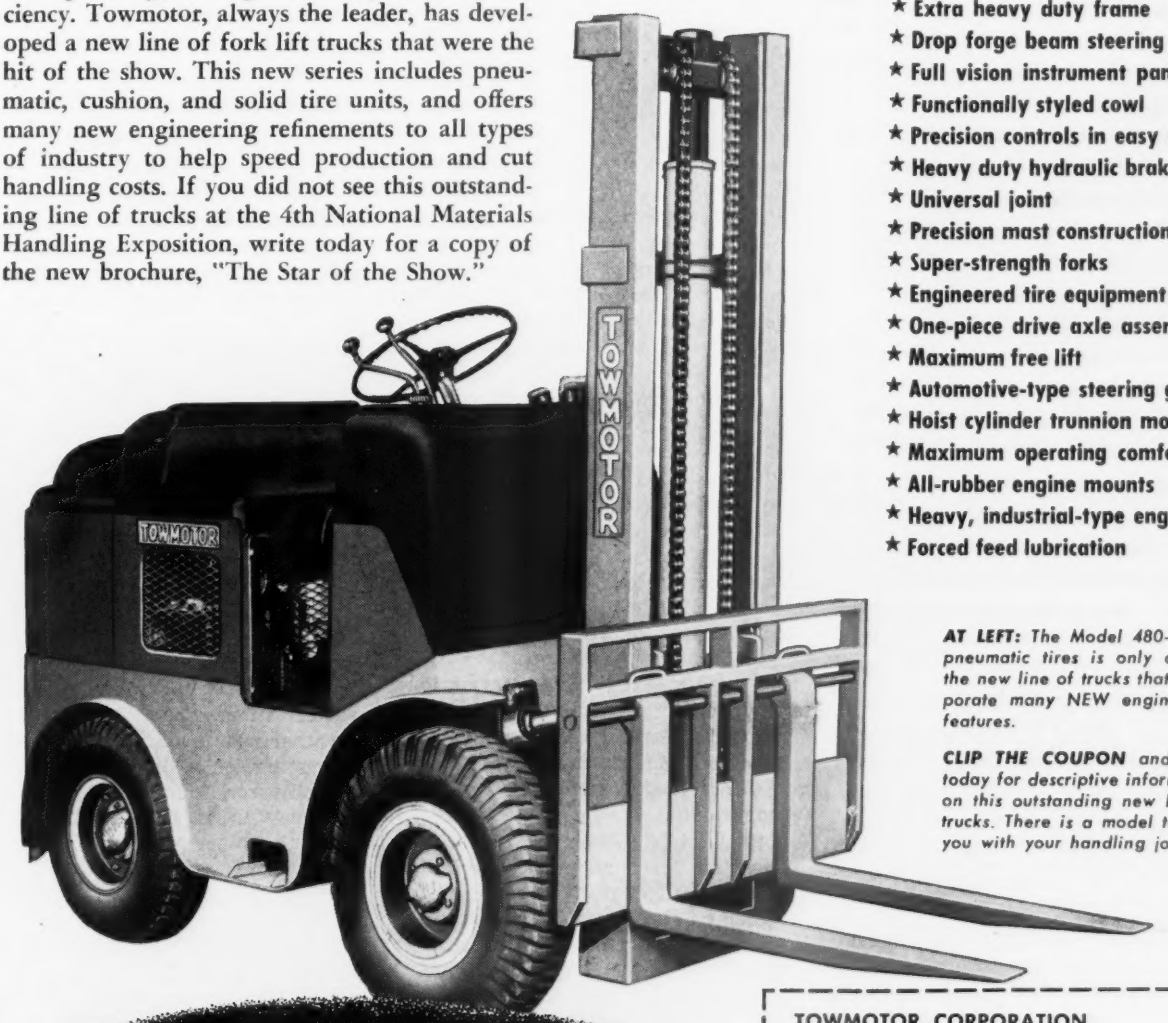

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Reader's COMMENT

Statements Are Confusing

TO THE EDITORS:

Perhaps I am not the only reader who has noticed some mistakes in the article, "Principles of Risering," by Charles F. Walton, in the April edition. I am happy to see articles concerning basic principles of foundry practice, but not when they are confusing. I refer to several statements made by the author:

1. "Pure metals and eutectic alloys solidify at a constant temperature so that in freezing they generally become mushy throughout and then become solid. Soft gray iron is typical of this type of solidification."

There are two errors here. Pure metals and binary eutectic alloys solidify at *a constant temperature.* Hence, they are special cases in which the liquidus and solidus temperatures are the same and *no* "mushy" condition (liquid plus solid) *can* exist. Anyone who has made copper castings can vouch for the statement that there exists no "mushy" condition during solidification. Likewise, "soft gray iron" is certainly not an example of this type of solidification. An iron containing 3 per cent carbon, 2 per cent silicon, and normal impurities would be a soft gray iron, yet its solidification range is in excess of 200° F! The mushy condition here arises from the formation of hypoeutectic austenite crystals. Even the eutectic does not solidify at a constant temperature, if the phase rule is correct, being at least a ternary alloy.

2. "Solid solution type alloys such as steel and brass solidify over a range in temperature. In freezing, the casting generally forms a solid shell at the surface while the center is entirely liquid." . . . . "Center-line shrinkage is typical of solid solution type alloys such as steel due to the formation of a solid skin or shell sufficiently strong to resist atmospheric pressure."

The author's terminology here is ambiguous. The term "solid solution type alloy" refers only to the microstructure of the solidified casting, and in no way is related to the mode of solidification. It is true that many alloys in this category show localized or "center-line shrinkage"; however, an even greater number exhibit general or "micro-shrinkage". One must also object to the use of the generic term "brass." Brasses are of many kinds and vary greatly in solidification range. The author, here, apparently refers to yellow brass.

Last, but not least, the formation of "center-line shrinkage" can hardly be ascribed to the fact that the initial solidification shell is resistant to atmospheric pressure.

If I may be permitted to insert my opinions in addition to my criticisms, I should summarize the situation as follows:

The solidification shrinkage characteristics of a casting alloy depend *primarily* upon its temperature range of solidification, i.e., the temperature increment between the liquidus and solidus. Alloy having a narrow solidification range, or pure metals and binary eutectics which have no solidification range, will normally show a very pronounced localized shrinkage cavity. Alloys having a wide solidification range are much more likely to exhibit general or microshrinkage.

The reason for this is rather obvious. From the instant an alloy begins to solidify within a mold, a temperature gradient is established between the surface and the interior. During solidification, heat is extracted by the mold wall and solidification proceeds from the surface toward the center. If the alloy has a wide solidification range, there will exist a rather wide zone within the casting consisting of a liquid-solid mixture (mushy condition). The outer surface will be at the solidus temperature, the inner at the liquidus temperature. Eventually, the center of the casting will drop below the liquidus while adjacent regions are still not completely solidified. Under such conditions, it is difficult to avoid microshrinkage because the completely solid and completely liquid regions are separated by a wall of "mush" through which "feeding" cannot occur. Consequently, the last portions of molten metal within the interstices of the solid crystals leave behind microscopic shrinkage voids as they solidify.

Where the solidification range is narrow, liquid and solid regions are in close proximity at all times during solidification and "feeding" can proceed normally by reason of the forces

(*Continued on page* 66)

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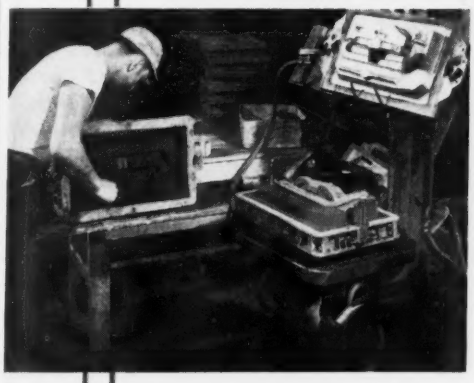

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(*Continued from page 64*)

of atmospheric pressure and/or gravity. Here, the center of the section is always the last to solidify, and since no shrinkage voids have formed previously, all the shrinkage is localized at one spot.

If I seem unduly severe in my criticism of the author, it is because I am personally acquainted with him and know he will accept my remarks with the spirit in which they are intended.

M. T. ROWLEY
Assistant Metallurgist
Ohio Injection Co.
Wadsworth, O.

●

AUTHOR'S REPLY:

The confusion which you noted in the recent article on risering was primarily due to the unwise condensation of a longer discourse on the subject, thus leading to over-simplification and generalization. Your criticism is in general quite sound. "Pure metals and eutectic alloys solidify at a constant temperature." The sentence is correct by accepted metallurgical definition (*ASM Handbook*) if it ends there. What was omitted was, "that casting alloys are seldom exactly either of these."

I do not believe that most gray iron foundrymen would agree with you that a 3 per cent total carbon iron is a "soft gray iron." With 2 per cent Si that iron could probably run well over 40,000 psi tensile. Generally iron for light castings without high physical requirements will have a carbon equivalent of 4.2 per cent or higher, i.e. (3.50 per cent C-2.20 per cent Si).

You do not state how you would identify an alloy that solidifies without a eutectic. It is true that "solid solution" only describes the final microstructure, but the inference is that it solidified as a solid solution. I know of no other suitable terminology. I heartily agree that the word "brass" was improperly used.

I do not know why you doubt that an alloy must withstand atmospheric pressure to develop centerline shrinkage assuming, of course, an absence of large quantities of occluded gases. It is generally agreed that an internal shrink is at a pressure much less than atmospheric, otherwise the Williams "atmospheric" riser would not function. If the solidified external shell of the casting would not withstand atmospheric pressure, it would collapse as it most commonly does with gray cast iron. The latter very seldom displays center-line shrinkage, unless an unusual condition exists such as with gassy metal. For the same reason it is unnecessary to use an atmospheric type riser with cast

(*Concluded on page 68*)

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(*Concluded from page* 66)

iron but is highly desirable with steel.

Your explanation of shrinkage characteristics mainly on the basis of solidification range is certainly a direct approach. I want to thank you for your comments. I value them since I know that you have been very successful with an engineering approach to the problems of casting a large number of different alloys.

C. F. WALTON
Assistant Professor
Metallurgical Engineering
Case Institute of Technology
Cleveland

* * *

Water Added to Blacking

TO THE EDITORS:

In the Questions and Answers section of the April FOUNDRY, there appears on page 138 an answer headed "Dry Sand Molds Scab and Blow." In the last paragraph on the page it is stated that "it is no longer necessary for each molder to mix his own wet blacking, but that blackings are prepared by reputable foundry supply houses ready for use with molasses water or any other soluble binding agent." Evidently, your commentator is not thoroughly familiar with modern practice. For some years the Springfield Facing Co. has been furnishing to the foundries a most satisfactory dry sand blacking which carries its own binder and to which only plain water is added in order to bring the mixture to the proper Baume.

H. E. BECKMAN
President
Springfield Facing Co.
Harrison, N. J.

* * *

Sorry, No Spanish Edition

TO THE EDITORS:

We have been receiving your magazine since 1928, as the enclosed clipping suggests. Since we would like to continue receiving it, but in Spanish, we would be much obliged if you could send it to us, under those conditions.

METALURGICA EXTREMENA, S.L.
Badajoz, Spain

* * *

Finds Copy Useful

TO THE EDITORS:

FOUNDRY at present is shared by our foundry superintendent and myself and supplied us by our company.

I always look forward to receiving a new copy and can truthfully say we use it as a guide for many up-to-date purchases.

CHARLES BROWN
Pattern Shop Foreman
A. B. Farquhar Co.
York, Pa.

Something new...

A double-duty foundry flux for use as a cupola flux and in ladle desulphurization

SULTRON®, the new double-duty flux, has a fast-growing army of users and in foundries all over the country its use is resulting in less bridging in the cupola, hotter, cleaner metal, more fluid slag, and prevention of free sulphur pick-up by the molten metal. It has greatly reduced costly cupola repairs.

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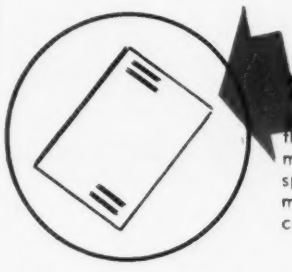

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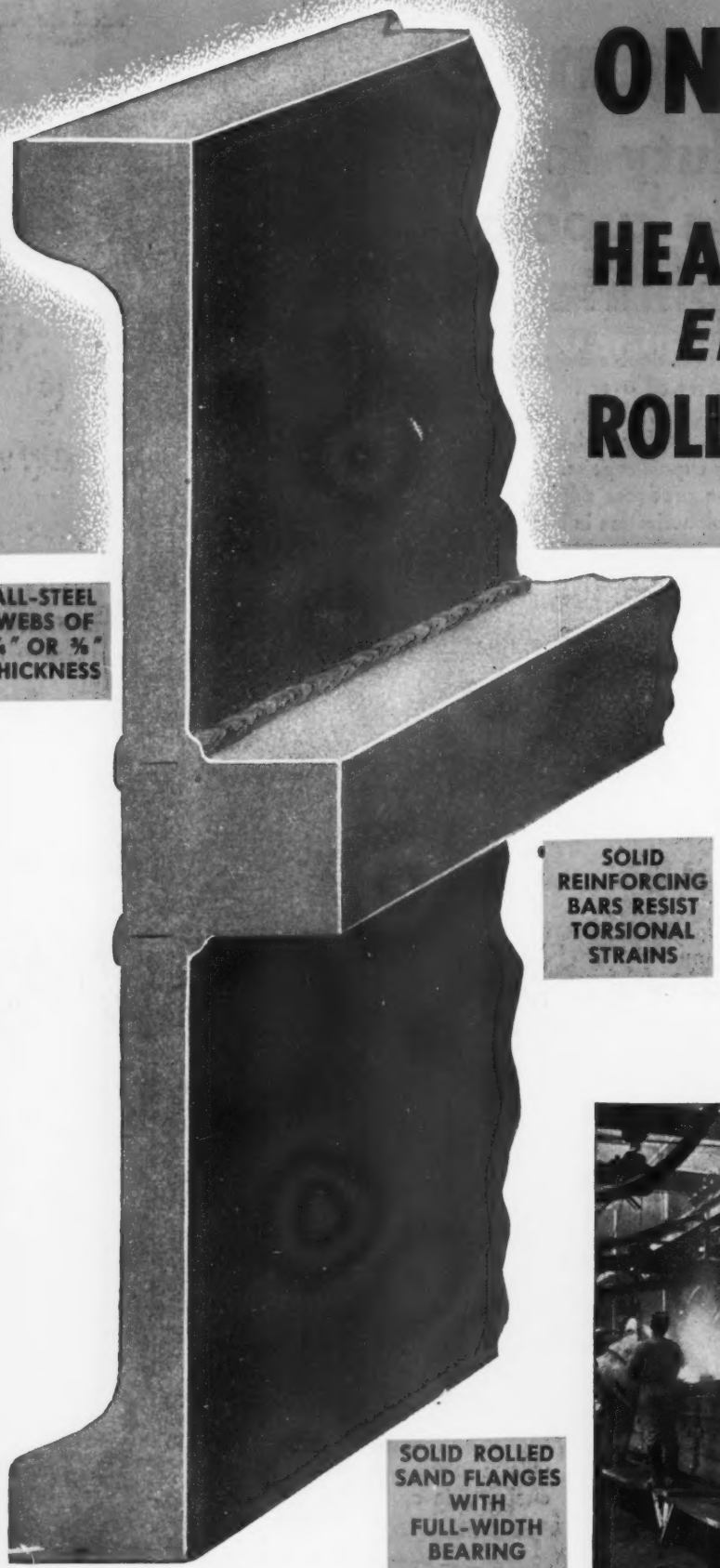
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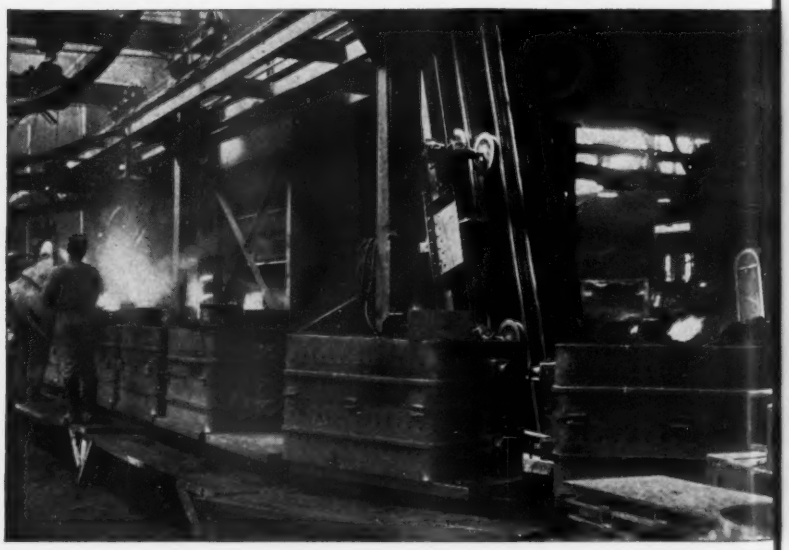


Pass Along Your Ratings!

PRODUCERS of foundry equipment and supplies report considerable difficulty in obtaining materials and components necessary for the manufacture and marketing of their various products. This situation stems from the increases in amounts of materials being channeled to defense and defense-supporting production. As the military takes a bigger bite out of available materials, the supply left over for civilian production grows smaller, and this may continue until new facilities, now contemplated or under construction, are completed. Regardless of the trend of the war effort in Korea, it seems probable that defense production requirements will move up for some months.

The steady increase in volume of materials required for defense production has complicated greatly procurement problems of many industrial concerns. Under present limitation orders, or with the Controlled Materials Plan when placed in full operation, manufacturers must provide information on rated orders if they are to secure their proper share of materials required to make their products.

This is the situation now facing the makers of foundry equipment and supplies. The time has come when foundrymen must pass along proper ratings with their orders for machines and supplies if the producers of these items are to secure materials in sufficient volume to fill the orders and permit foundries to meet present heavy demands for castings.

While the need for ratings to obtain steel and other metals is apparent, the importance of ratings for other materials is just as real. For example, paper bags are in such short supply that producers of binders, seacoal, foundry facings and similar products cannot obtain these shipping containers unless they have proper ratings from customers.

Since castings are basic materials in building for either war or peace, and since the volume of defense work in foundries is growing, foundrymen should have no difficulty in providing equipment and supply manufacturers with ratings. They can pass along the DO ratings for defense and essential civilian work in the plant, use MRO when applicable, and request ratings from Washington for purchase of equipment.

Foundries requesting priority assistance should address a letter to A. J. McDonald, chief, Iron and Steel Castings Section, National Production Authority, Washington 25, D. C., giving the following information: Copy of purchase order showing order number, name and address of supplier; description of machine; delivery required; deilvery promised with rating; delivery promised without rating; backlog in dollars; percentage of all rated orders; list of defense order numbers with ratings; description of products manufactured by applicant, both normal and defense. Do not use Form NPAF2, which is being supplied by district Department of Commerce offices for the purpose.

Equipment and supply manufacturers deserve all the help foundrymen can give in meeting the emergency program. So provide them with proper ratings.

Frank G. Steinebach
Editor

By H. W. LOWNIE JR.
Battelle Memorial Institute
Columbus, O.

NEED STRONGER Foundry Coke

NEW information, not published previously, on the performance of foundry coke in cupolas has been developed during the last year. This discussion is restricted largely to findings supported by quantitative evidence, and the report is made possible by the release of research data by two large users of foundry coke—the Gray Iron Research Institute and the Ford Motor Co. The paper is based on a talk presented to the American Coke and Coal Chemicals Institute, Western Regional Meeting, Chicago, Mar. 7, 1951.

A DETAILED study was made in 1942 of the effects of coke on cupola operations in over 20 foundries, all members of the Gray Iron Research Institute. These foundries were scattered geographically from Missouri to Connecticut, and from Wisconsin to Alabama. They make a wide variety of iron castings, piston rings, heavy auto-body dies, and many others. About a week was spent studying each foundry's operation. A large mass of data was accumulated and two important conclusions were drawn. One of these has been discarded since, and the other has been strongly supported by much additional evidence.

The finding that has been discarded was that cokes that performed well in the cupola also had a high temperature rise in a combustibilty test. In this test, samples of the coke were burned in oxygen under controlled conditions, and the ignition temperature, temperature rise, and rate of combustion were measured. Since 1942, this test has been used on many cokes rated from very good to very poor by various foundries. The correlation between the combustibility test and coke performance in the cupola has not stood the test of time during the last nine years. Today, the combustibility test is not considered a dependable means for predicting the performance of coke in a cupola. However, the test is still made, because some day the results may be worked into a general pattern that will help in the prediction of coke performance.

The second conclusion from the 1942 survey was that stronger cokes gave better performance than weaker cokes in the cupola. Coke strength still seems to be the best available measure of how coke will perform in a cupola. Commercial foundry cokes that are strong rarely give poor performance in a cupola.

Since 1942, the Gray Iron Research Institute has continued research on foundry coke. This research has been directed toward determining what characteristics are desirable in foundry coke.

For about ten years, numerous tests have been made on samples of coke that were rated by foundries as unusually good or unusually poor in some respect. Yet, no single test has been developed to predict completely coke performance in a cupola. Part of the difficulty may lie in the difference in requirements of various foundries. Similar cokes are sometimes considered good in one foundry and poor in another, depending upon the end result each foundry desires, or on the nature of the foundry's product.

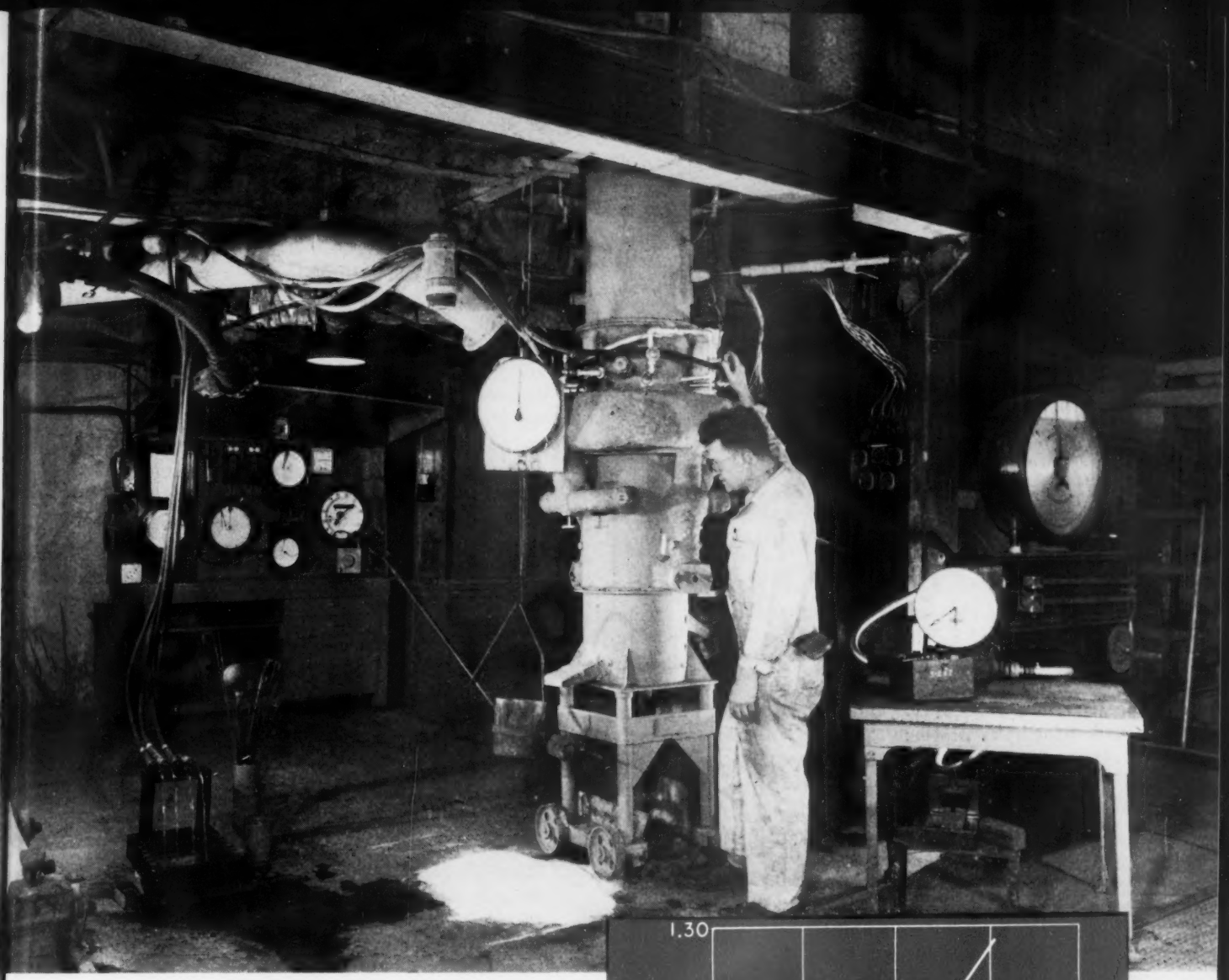
It is a major problem to obtain reliable information on the performance of coke in commercial foundries. The nature and composition of the raw materials used in cupola melting, including the coke, usually vary even within a single day. The press of production usually makes it difficult to conduct tests under the closely controlled conditions necessary to obtain reliable data.

Experience has shown that reliable tests on foundry coke can be made in commercial foundries when three main conditions are satisfied. They are:

1. The operation must be put under full-time observation by qualified and experienced engineers not responsible for production during the tests.
2. Calibrated special measuring equipment not usually needed for normal day-to-day control of the operation must be installed and used.
3. The personnel making the tests must be permitted to interfere with normal production when necessary for the purposes of the tests.

These three conditions become expensive when applied in commercial foundries. The problem of testing foundry cokes has been simplified by the successful development of the 10-in. experimental cupola at Battelle under the sponsorship of the Gray Iron Research Institute. This cupola has been described in the literature and has been copied by several laboratories and schools. The shell is 18 in. in diameter, is lined to 10 in. in diameter, and is about 10 ft high. It is equipped with many features to permit close control of the melting operation.

Eight years of development on this cupola and the production of about 150 heats under closely con-



Experimental 10-in. cupola developed at Battelle Memorial Institute under sponsorship of the Gray Iron Institute has proved valuable in coke studies

trolled conditions have resulted in this cupola being a good and proven research tool. The 10-in. cupola bridges the gap between the usual laboratory test and commercial cupola operation. When the results obtained with the small unit in several different types of investigations have been checked in commercial cupolas, the agreement has been good. Of course, a small unit of this size has its shortcomings. For example, it is not dependable for measuring the tendency for coke to break up during its use in the cupola. However, in all other respects its operation simulates that of larger commercial cupolas. It has permitted the accumulation of useful information on cupola operation and foundry coke more quickly and at lower cost than by any other method known.

Comparison of 1942 and 1950 Cokes—During the last several years, cupola operators have become concerned about a reduction in coke "quality." Two complaints are common. First, more coke has to be used now to get the same tapping temperatures from the cupola. Second, the melting iron picks up less carbon from the coke than it did in the past. This

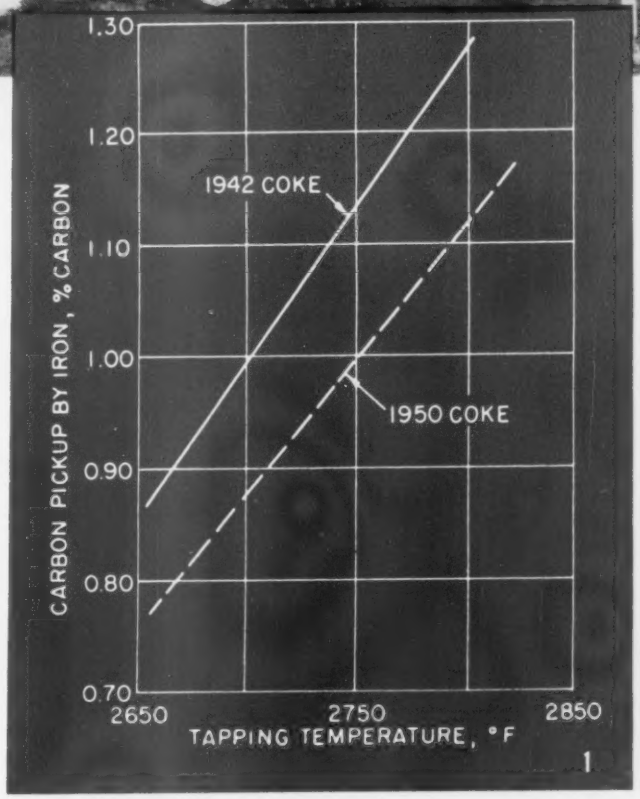


Fig. 1—Relation of carbon pickup by the iron to its tapping temperature for cokes produced in 1942 and 1950. Data from 10-in. cupola with 2.45 per cent carbon in charge and 7.5/1 coke ratio

Foundry Coke

lower carbon pickup by the iron is a serious problem in many foundries. Lower carbon pickup requires that more pig iron be used in the cupola charges at a time when the merchant pig iron available to iron foundries is in very short supply.

During the last year, the differences between two cokes produced eight years apart were checked on a research basis. From 1942 to 1950, the 10-in. cupola was operated on a single lot of foundry coke that was produced in 1942. After over 100 heats were made with this coke, under a wide variety of cupola conditions, its characteristics were well known. In 1950, the supply of this coke ran out, and it was replaced with another lot. The new 1950 lot of coke was produced from similar coals and by almost the same coking time as the 1942 coke. Table I compares the properties of these two cokes. Based on the analyses and properties of foundry cokes supplied to commercial foundries in 1942 and in 1950, these two cokes used in the 10-in. cupola were fairly representative of commercial foundry cokes made during 1942 and 1950. The higher ash content and lower fixed-carbon content of the 1950 coke, as compared with the 1942 coke, are typical of foundry cokes produced during these years.

Table II presents a comparison of the performance of the two cokes in the 10-in. cupola. When both cokes were of the same size, the 1950 coke gave lower tapping temperatures and lower carbon pickup by the iron. Eight heats were made to compare these two cokes, and the differences in performance recurred under a variety of operating conditions.

The performance of the 1950 coke in the 10-in. cupola forced a change in an excellent relationship that had been developed for the 1942 coke. This is shown in Fig. 1. With the 1942 coke, an almost linear relationship was established between the tapping temperature of the iron and the amount of carbon that it picked up from the coke. With the 1950 coke, there was also a linear relationship between tapping temperature and carbon pickup, but the carbon pickup by the iron was much lower for any given tapping temperature.

For comparable conditions of cupola operation, the 1950 coke also gave a lower tapping temperature than did the 1942 coke. This relationship is shown in Fig. 2. Thus, for any given set of operating conditions, the 1950 coke gave lower tapping temperatures and much lower carbon pickup by the iron than did the 1942 coke. Fig. 2 also illustrates the general effects of blast moisture content and blast temperature on the tapping temperature of the iron produced with either coke. These effects are described later.

After several months of study of the 1942 and 1950 cokes, it was apparent that different cokes of quite similar analysis can and do perform much differently in a cupola. The trend of the results was the same as operating foundrymen have reported in commercial operations: (1) the 1950 coke gave lower tapping temperature than the same amount of 1942 coke, and (2) the 1950 coke produces less carbon pickup by the iron than the 1942 coke.

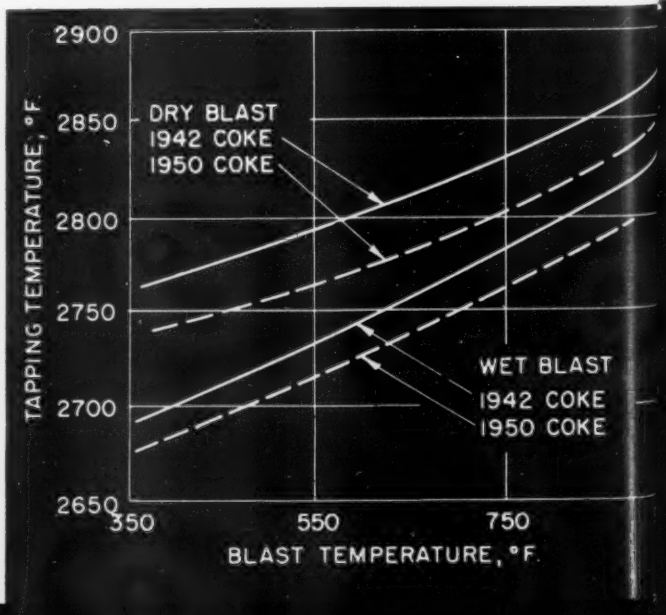
The 1942 and 1950 cokes have been submitted to many conventional laboratory tests. Although the cokes differ in such important characteristics as ash content, fixed-carbon content, and ignition temperature, no single coke property, or combination of properties, can be pointed to as the definite cause for their difference in performance. It is hoped that future work on these and similar cokes will throw more light on the subject.

Earlier in this paper, the important effect of coke strength on the performance of foundry coke in the cupola was mentioned. Coke strength is a factor that cannot be studied dependably in the 10-in. cupola. In this unit, materials are charged gently, crushing loads are low, and the coke is broken to a small size and carefully screened before being used. However, during 1950 an excellent opportunity was presented for studying the performance of several cokes in a production foundry.

Coke Tests in a Commercial Foundry—A 54-in. cupola in the River Rouge plant of the Ford Motor Co. was equipped with special controls and measuring equipment, and placed under the full-time observation of a group of Battelle and Ford engineers. Several cokes were tested in the production of 93 heats averaging about 65 tons each. Over 6000 tons of iron and 1000 tons of coke were involved in the tests.

Interesting information was obtained on nine cokes, which included oven and beehive cokes. Discussion here is restricted to two oven cokes, a 16-hour foundry coke and a 28-hour foundry coke. The problem was to measure the comparative performance of these cokes. Both cokes would melt iron, but the melting operation was more dependable and satisfactory with the 28-hour coke. Performance ratings of the cokes

Fig. 2—Effects of cupola operating conditions on tapping temperature of 1942 and 1950 foundry cokes



overlapped somewhat. Some of the better heats with the 16-hour coke were as good as some of the poorer heats with the 28-hour coke. However, the foundry was much less likely to get into trouble when using the 28-hour coke.

The obvious question is—how did the two cokes differ? By variations in coal blending, the two types of coke were made similar in proximate analysis, as shown in Table III, so this was not the main difference. On the basis of their analyses, the 16-hour coke, with its higher fixed-carbon content, would usually be considered superior to the 28-hour coke. However, the performance of the 28-hour coke was better than that of the 16-hour coke.

The big difference between the 16-hour and 28-hour cokes was their resistance to breakage. Coke strength and coke size are related. Even though a weak coke and a strong coke are sized the same at the ovens, as they were in these tests, the weaker coke goes into the cupola smaller and breaks up more in the cupola. The ranges of size for these two cokes at the charging floor are shown in Fig. 3. The 28-hour coke was larger and it performed better. With the 28-hour coke, iron could be melted faster and hotter than with the 16-hour coke. The sizes of the two types of coke overlapped much as the performance ratings overlapped.

Fig. 4 shows the average results for the 16-hour and 28-hour cokes in the shatter test and, again, shows that the 28-hour coke was stronger. These differences in strength occurred even though an effort was made at the coke ovens to produce a stronger 16-hour coke.

In addition to being smaller when it went into the cupola, the 16-hour coke also broke up more in the cupola. The evidence of this and its effects are shown in Fig. 5. With small 16-hour coke, the maximum blast rate that could be put through the cupola with a given centrifugal blower was reduced. Reduced blast rates lowered the melting rate and slowed the entire rate of production for the foundry. Fig. 5 shows another disadvantage of the small 16-hour coke. Even at a fixed rate, it gave lower tapping temperatures than larger and stronger coke. This effect of coke size has also been found in heats made in the 10-in. cupola with other cokes.

Fig. 5 suggests an obvious question—why not use a larger blower when using the smaller coke? There is both a technical and a practical answer to this. Technically, the small 16-hour coke did not respond normally to higher blast rates. With the stronger 28-hour coke, tapping temperatures increased when the blast rate was increased. With the 16-hour coke, tapping temperatures soon reached a peak at a rather low temperature, and then started down as the blast rate was increased further. This behavior was called "over-blowing."

The practical objection to higher blast rates with the small 16-hour coke is that higher pressures in the cupola require blowers of higher pressure ratings. Higher pressure ratings in blowers of this size are quite costly.

These extensive tests in a commercial production foundry reinforced the growing conviction that coke

TABLE I—Comparison of 1942 and 1950 Cokes

Coke	Coal Mixture	Coking Time
1942	58 Pocahontas 42 Imp. Eagle	29 hours
1950	51 Pocahontas 49 W. Va. Eagle	27 hours

	—Proximate Anal., %—				Modified Boegehold Combustibility Test	
Coke	V.M.	Ash	F.C.	S, %	Ign. Temp., °F.	Temp. Rise, °F.
1942	1.8	7.2	91.0	0.6	853	422
1950	1.3	9.9	88.8	0.6	935	409

TABLE II—Comparison of Coke Performance*

Type	1942	1950
Size, in.	1¼ x 1¾	1¼ x 1¾
Tapping temp., ° F.	2760	2730
Carbon in iron, %	3.60	3.40
Silicon in iron, %	1.98	1.91
Chill depth, $\frac{1}{32}$-in.	12	17
Stack gas, % CO_2	11.5	13.0

* Results of eight heats in 10-in. cupola, 7.5/1 coke ratio. Blast dry, 350° F, 23 lb/sq ft/min.

TABLE III—Analyses and Properties of Two Oven Cokes Tested at Ford Motor Co.

Coking Time, Hours	No. Of Tests	Avg. Composition, % H_2O	V.M.	Ash	F.C.	S	Cell Space, %	True Sp Gr
28	43	1.8	0.7	9.0	88.5	0.5	53.5	1.88
16	22	0.7	0.4	9.0	89.9	0.5	53.9	1.86

TABLE IV—What Metallurgists Want in Coke

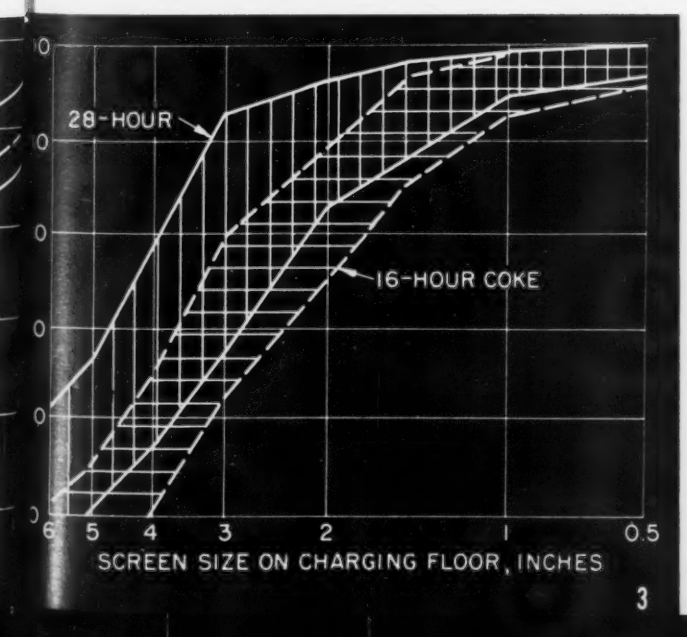
(Foundries written—21. Foundries replying—19)

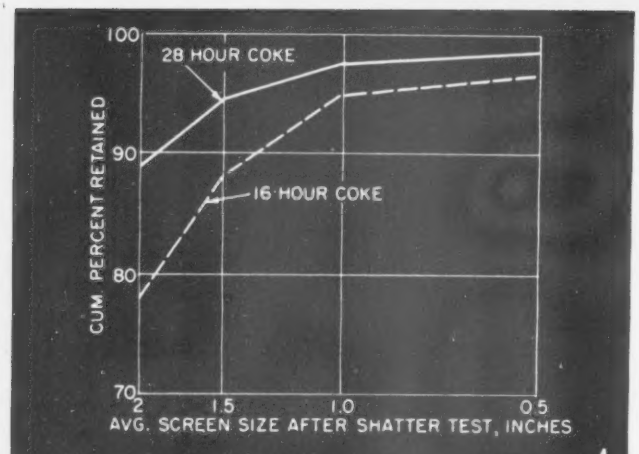
Property	Number
Greater strength	17
Larger coke, less undersize	14
More uniform from car to car	12
Lower ash, higher fixed carbon	8
Higher carbon pickup by the iron	7
Lower sulphur	4
Furnish analysis with each car	3

TABLE V—Results from a Hot-blast Cupola

	Blast Temp., ° F 80	450
Lb coke/ton iron	250	180
Iron melted, ton/day	400	400
Coke saved, tons/day	...	14
Tapping temperature, ° F.	2560	2735
Pig iron, % of charge	45	20
Coke saving, per day	...	$295
Cost of gas to heat blast, per day	...	$ 45

Fig. 3—Comparison of size distribution of two oven cokes sampled from Ford Motor Co. charging floor





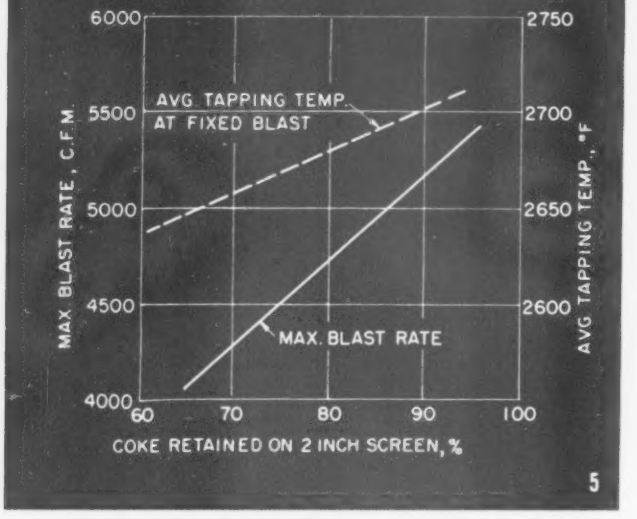


Fig. 4—Average shatter-test data on two types of coke tested in production at Ford Motor Co.

Fig. 5—Effects of coke size on maximum blast rate and average tapping temperature of cupola-melted irons. Data obtained in production tests on a 54-in. cupola at Ford Motor Co. foundry

strength and its dependent relative, coke size, are vitally important in cupola operations.

What Foundry Metallurgists Want—In February, 1951, a letter was sent to the metallurgists of 21 gray iron foundries. They were asked what they thought coke producers could do to foundry coke to make it more suitable for their operations. The metallurgists were given no suggestions as to their answers. Most of the 19 replies received contained several suggestions. The suggestions are tabulated in Table IV. Of 19 metallurgists 17 asked for higher strength, and 14 asked for larger coke or coke with less undersize. Because strength and size of coke are intimately related, it is obvious that foundry metallurgists, from their practical experience in production, have reached the same conclusions as those developed from research work.

What Foundries are Doing—Faced with a general deterioration in coke "quality," foundries are making efforts to help themselves as much as possible. They realize that coke is fragile. As it becomes possible for foundries to install more equipment, considerable attention is being given to methods of handling coke more gently and storing it under better conditions. However, because these changes in equipment are expensive, the changeover is being made slowly. Many foundries that must still handle coke by older methods are finding that their operations are improved if the coke is forked before charging into the cupola so as to remove most of the fine material.

Improvement in coke-handling equipment still leaves unsolved the problem of coke breakup after it is charged into the cupola. Therefore, many foundries are looking for other means of overcoming deficiencies in coke strength. Blast preheating and blast drying seem to offer an attractive possibility. Preheated cupola blasts up to about 400°F have been used for a number of years in a few foundries. However, with cheap coke of adequate strength, the capital investment in blast-heating equipment was usually not economically attractive. As coke problems increase, the advantages of blast preheating become much more attractive.

Table V shows the results of a typical commercial hot-blast installation that has been in operation in an Ohio foundry for about one year. The blast preheat of 450°F permits an appreciable saving in coke requirements. At the same time, tapping temperatures were increased and the amount of pig iron in the charge was cut in half. In addition, the operation with the preheated blast is more flexible and cleaner than before, and the blast temperature provides a method of compensating for variations in coke quality from car to car.

Until recently, there were materials problems that tended to limit economical blast temperatures to about 450°F in blast heaters fired by an external fuel. Recent research work by the Gray Iron Research Institute in the 10-in. experimental cupola has indicated that improvements in cupola operation can be expected with blast temperatures up to at least 1000°F. On the basis of these findings, a large hot-blast unit capable of heating the blast to 1000°F has been installed in a large production foundry and began operation in February, 1951. The heater is fired with fuel oil. It is still too early to report on the results obtained with this new unit, but its performance is being watched closely by other foundries in the hope that it will go a long way toward giving them a means for compensating for lower and variable coke quality.

Conclusion—Many of the foundryman's operating difficulties could be reduced if he were supplied with a larger and stronger coke. At least, higher strength and less undersize are two things that most foundrymen want. Research on the subject will continue in laboratories and in foundries in an effort to find some test that can be applied to foundry coke to predict its performance in the cupola. Meanwhile, it appears that higher strength foundry coke would be a big help to gray iron foundries. Consider higher strength a stop-gap measure, if you must, but at least it is something definite that coke producers could give to improve cupola operations. Perhaps later, more definite requirements or properties can be suggested. For the present, the need for higher strength foundry coke has been well proved in research tests and in commercial production.

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Steelmaking for Castings

Operating practice with the basic open-hearth furnace is detailed in this fifth and concluding article on steel foundry melting operations with the open-hearth unit. The series started in the March issue

IN STEEL foundries using basic open-hearth furnaces, the proportion of pig iron to scrap, though lower than in typical rolling mill practice, is higher than in acid operation. Briggs[1] gives the proportions shown in Table I as characteristic of the practice in four different steel foundries. Plant *A* used large amounts of high-carbon steel springs and cast-iron motor blocks, so that it was able to reduce the proportion of pig iron in the charges below what is possible in the average foundry. Ten or fifteen per cent shop scrap, used in plants *A* and *B*, is very low, and the 40 to 50 per cent shown for plants *C* and *D* is more representative of normal practice.

Sometimes the charge is proportioned to contain as little as 1 per cent C, but usually from 1.50 to 2 per cent is preferred. With this amount of carbon, the steel at melt-down will usually contain 0.50 to 0.75 per cent, which is high enough to give a vigorous boil. Most authorities recommended a melt-down carbon content of at least 0.40 per cent above that desired in the finished steel. The silicon in the charge should preferably be under 0.50 per cent, though a higher amount can be used by charging additional lime. At melt-down, the silicon is generally reduced to some 0.02 to 0.03 per cent.

If possible, the S in the charge should not exceed 0.045 per cent, and the P, 0.065 per cent. The Mn will run 0.45 to 1.25 per cent. To secure more workable slags and promote the elimination of sulphur, some operators prefer to have as much as 1.40 or 1.50 per cent Mn in the charge. The extra amount may be obtained from ferroalloys, or from manganese ore added with pig and scrap, as illustrated in the heat detailed in Table II. At melt-down the metal will generally contain 0.20 to 0.40 per cent Mn.

In recent years it has become standard practice in most steel foundries operating basic open-hearth furnaces to use petroleum coke, metallurgical coke or crushed graphite in the charge. In this way the proportion of pig iron can be reduced greatly at a considerable cost saving. Even if the coke is deeply buried in the charge, the amount of carbon absorbed from it is not over 70 per cent of its total weight; with graphite, a better recovery is obtained.

Charging—The magnesite lining of a basic furnace hearth resists the attack of FeO so well that the steel scrap may be placed first, in direct contact with the bottom, and the pig spread over the top of the charge. In this position, the pig to some extent protects the scrap from oxidation and thus decreases the amount of FeO produced in melting. The usual practice is to spread plate scrap in an even layer over the bottom, then charge the lime and the coke or graphite, cover them with the rest of the scrap, and distribute the pig as evenly as possible over the top of the heap. As it is almost never possible to get the whole charge in at once, the first material placed must be partly melted down to make room (*Please turn to page* 232)

TABLE I—Proportions of Metallic Charge

	Plant			
	A	B	C	D
Pig, per cent	10	25	25	30
Shop scrap, per cent	15	10	40	50
Purchased scrap, per cent	75	65	35	20

TABLE II—Heat Using Manganese Ore Addition

Charge	Weight, lb
Pig iron	12,000
Shop scrap	8,500
Cast steel scrap	6,000
No. 1 heavy melting steel	8,500
No. 2 heavy melting steel	8,000
Rails	11,000
Wheels	6,000
Total	60,000
Tar coke	250
Manganese ore	600
Burned lime	2,600

		LOG OF HEAT				
Time	Item	C	Mn	Si	P	S
8.20	Charge					
12.25	Melted					
12.30	Test No. 1	0.60	0.34	0.016	0.012	0.035
12.35	400 lb ore					
12.45	Test No. 2	0.40	0.33	0.016	0.007	0.032
12.50	200 lb ore					
1.00	Test No. 3	0.36	0.35	0.006	0.007	0.031
1.08	Test No. 4	0.28	0.34	0.002	0.007	0.029
1.13	Test No. 5	0.25	0.35	0.000	0.009	0.029
1.14	500 lb 15% ferrosilicon					
1.22	Tap					
540 lb 50% ferrosilicon in runner. 20 lb tar coke in runner. 244 lb 80% ferromanganese in ladle						
Analysis of 35th mold		0.27	0.63	0.40	0.021	0.029

From J. W. Porter, *Transactions*, AFS, Vol. XLVII, 1939, p. 296-297.

Some Recent Developments in

Centrifugal C

This is the first of two articles in which the authors describe certain recent advances in the field of centrifugal casting, particularly in the method employing metal molds. A number of process improvements effected have made possible various new or improved products

DURING World War II there was a pronounced upsurge in the extension of centrifugal casting methods for the production of various wars materiel items. Two principal centrifugal methods were employed on a large scale. The first was the true centrifugal casting process which requires no internal core and in which hollow cylindrical bodies are generated. Both sand-lined and metallic molds in either horizontal or vertical positions were in use. The second was the centrifuging process in which molten metal is introduced centrally in a vertical gate and is hurled horizontally outward by centrifugal force into single or multiple sand mold cavities.

Since the end of the war, considerable developmental work has been carried on in this field, particularly along the lines of true centrifugal casting. The authors have been primarily concerned with the centrifugal casting of hollow cylinders with the use of metal molds rotating in a horizontal position and, hence, some of the more recent process and product developments obtained with this method will be described.

Modern Metal-Mold Centrifugal Process—The use of metallic molds in the art of centrifugal casting is old. Millions of tons of cast iron pipe have been made by the well known deLavaud method, in which the metal mold, mounted in a waterbox, is inclined slightly and the molten metal is introduced into the rotating mold by means of a trough extending through it, the relative retraction of the mold away from the pouring end of the trough forming a helix of liquid metal which is pressed against the inner mold surface by centrifugal force to form a pipe.

Another major use of metallic molds is represented by the Watertown Arsenal centrifugal gun casting method, in which molten steel is introduced into a thick-walled, rotating horizontal metal mold from one end through a suitable orifice mounted on a special pouring box. Short-length tubular steel products such as aircraft cylinder barrels and various cylindrical tank parts were made in horizontal metal molds in considerable quantity during the last war. These methods have become fairly well known.

Within the last decade a process development has materially changed the picture in the field of true centrifugal casting. It has made possible the combining of the many benefits of rapid solidification associated with the use of metal molds, with the ease of casting normally associated with processes utili[illegible] slow freezing.

In this process the metal mold, preheated to temperatures preferably above 300° F, is coated prior to casting with a thin coating of a refractory, insulating material. It is recognized that the idea of coating molds by brushing, swabbing, flooding or spraying is old in the art of founding. What is important is the control that has now been incorporated in the coating operation and the results that accrue therefrom. The coated process is essentially as follows:

The hollow cylindrical mold, preheated to a suitable temperature, depending on the refractory material to be sprayed and on the type of product to be cast, is rotated on a horizontal axis while the slurry, carrying the insulating coating material, is sprayed from a gun which traverses the length of the mold in a longitudinal direction. A thin deposition of coating material per pass is thereby assured and, depending on the final thickness of coating desired, one or a number of passes of the spray gun are used. By proper adjustment of the coating application variables, a balance is attained between the rate of deposition of the spray globules and the rate of evaporation of the liquid carrier of the refractory insulating solids in the slurry. Consequently, drying of the sprayed globules on the mold surface is practically instantaneous, assuring that each spray particle sticks where it lands, thereby building up incrementally a coating having a rough, tractive surface.

The basic requirements of the coating are (1) that it offer traction to the molten metal so that it can be picked up readily in a circumferential direction and to prevent its slippage in a longitudinal direction, (2) that it be insulating so that the leading edge of the metal is momentarily retarded in its freezing to permit fusion with the molten metal sub-

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Casting

sequently flowing over it, (3) that it be thin so as not to retard significantly the overall freezing rate of the casting, (4) that it be sufficiently strong to resist the washing action of the molten metal and sufficiently refractory to withstand the temperatures developed during casting without decomposition or melting, and finally (5) that it be friable to facilitate the withdrawal of the casting from the mold. (For further details consult U. S. Patent No. 2,399,606.)

The use of a properly coated mold, as described, has made possible a number of process and product developments. The need for a trough extending through the length of a mold and the retractive movement of such a trough during the casting operation is eliminated. Instead the metal is poured through a horn gate which reaches into one end of the horizontal rotating mold. The mold coating then makes possible the smooth distribution of the molten metal in both circumferential and longitudinal directions without slippage, thereby avoiding the formation of injurious surface defects such as localized cold shuts, laps, and pinholes.

Several years ago true centrifugal casting in metal molds faced a serious limitation in the length of castings that could be made without the use of a trough. This limitation has now been greatly reduced by this new casting method. The problem of length becomes more difficult as the OD of the casting diminishes, but it is now possible to cast 1.9-in. OD piping to 10-ft lengths. In the 6-in. size of piping 15-ft lengths of stainless steel have been successfully cast and longer lengths appear feasible. Certain problems are encountered with increase in diameter of castings; however, 30-in. castings in cast irons and 24-in. castings in steels are now being made. The as-cast wall thickness ranges from 0.2-in. for small diameter castings to a number of inches for the larger diameter castings.

When the word "casting" is employed, one of the first questions arising in the mind of a designer is that of soundness of the casting. By virtue of its inherent geometry, the centrifugal casting of a hollow cylindrical body is normally a much simpler problem than statically casting a highly irregular-shaped body, the heat flow governing the solidification being much more amenable to control. If to this is added the provision of a steep (*Please turn to page* 218)

Casting a cylindrical part by the centrifugal process in a metal mold

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Gas

THE problem of gas from cores and molds has always been regarded as something that exists but which is not sufficiently tangible to put down on paper in a way that will clearly show when and why blowholes, misruns and cope draws can be expected due to a condition in the sand.

It is well known that different binders give off varying amounts of gaseous materials when the sand containing them is subjected to heat, and the amount of gas in cu cm/gram can be quite easily measured in a simple laboratory test. In this test, a weighed sample of sand is placed in a combustion boat and ignited at 1800° F for 10 minutes, the products of combustion being led off and measured by volume.

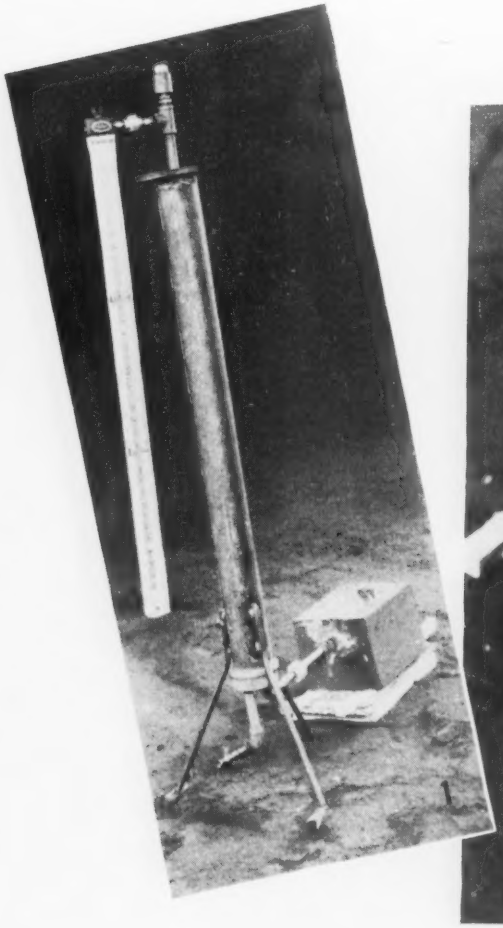
Consider a few typical results before proceeding further:

Dry Binders	Average Values, cu cm/gram
1% Wheat flour	5.87
1% Sugar binder	4.39
1% Gilsonite binder	4.75
1% Pitch	6.16
1% Resin binder	6.06
1% Starch cereal	7.66

The exact amount of gas will, of course, depend on the degree to which the sample has been baked and the temperature at which it has been baked. In general, the higher the baking temperature and the longer the baking time, the less the gas obtained from the mix.

As an example, take gilsonite binder and resin which have been dried and not baked. The gas given is 5.00 cu cm per gram and 8.60 cu cm per gram. The figure for resin in this case is considerably higher than the figure obtained after baking.

Core oils in general give about the same amount



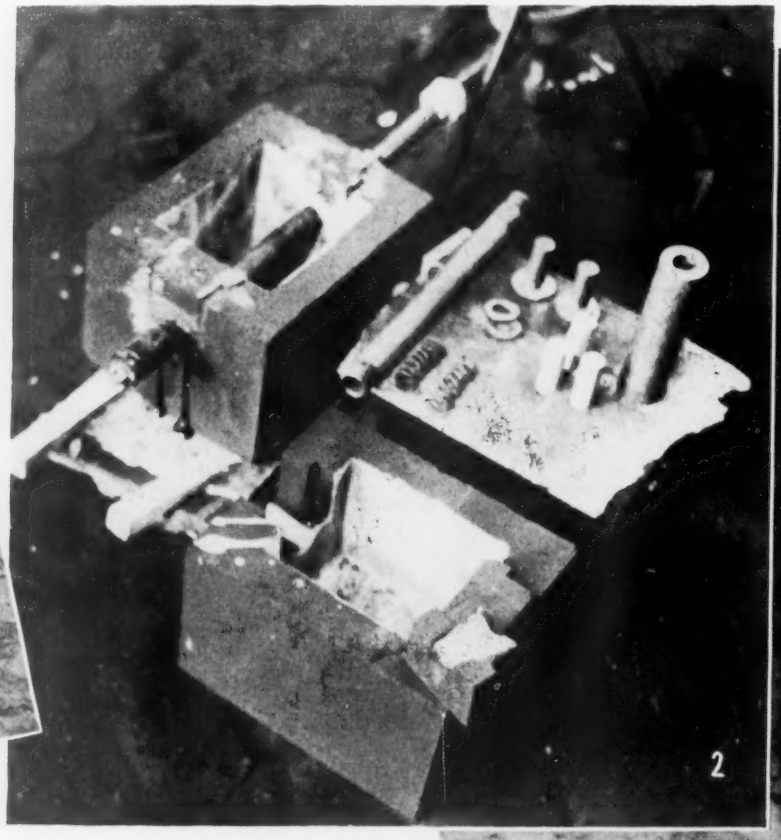


Fig. 1—Original apparatus, a standard orifice, used to measure rate of gas flow from a mold. Fig. 2—Details of the equipment.

Fig. 3—Apparatus as revised to incorporate a sand body orifice

Factors influencing the evolution of gas from molds and cores, including moisture and underbaked cores, and the effect on castings are discussed. A relatively simple method of measuring the amount of gas from any sand mix for molds and cores was employed in conducting this study

Evolution

FROM MOLDS AND CORES

of gas under identical conditions. The average values range from 4.00 cu cm/gram to 6.10 cu cm/gram, most of the commercial oils falling somewhere between these limits. Underbaked oil sands are liable to give off excessive quantities of gas. The amount of gas is, of course, proportional to the amount of binder in the sand. There is, therefore, a relatively simple means of comparing one type of binder with the next but it is not so simple to correlate this information with any tendency for the materials to give trouble in casting attributable to the amount of gas they produce.

Consider now the next most important phase of this problem viz., the mold or core permeability. For the sake of simplicity, the effect of vents to augment the permeability is not considered at this stage. The permeability of a sand is a relative measure of the ability of the sand to carry gas. The test is relative only because it applies strictly to laboratory conditions. With a standard rammed sample of sand, it is possible to pass 2000 cu cm of air through the sample at a 10-gram pressure in a certain time. Measuring this time and substituting in the permeability formulae gives the permeability number.

If now the air is forced through the specimen at a faster rate, a resistance pressure can be expected to build up in the sand sample. There are two factors —the amount of gas generated within a sand and the ability of the sand to carry away this gas. Where the gas generated is high and the sand permeability is low it can be expected to build up quite a high resistance pressure within the sand body. Where the gas generated is zero, a zero permeability in the sand should be required. This statement is absolutely correct if the effect of voids in the sand on sand expansion and other heat phenomena is disregarded.

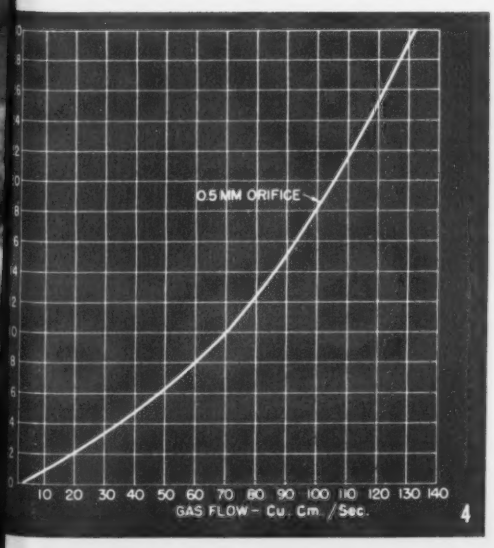
It does not matter how much gas is produced during casting if there is sufficient time for the gas to travel through the sand without building up a resistance pressure in the sand body. The chief concern, therefore, is the rate of gas production rather than the total volume produced. An attempt was made to measure the rate of gas evolution in cu cm/second and correlate this with the ability of the sand to carry gas and the resistance pressure built up in the sand body due to the flow of different amounts of gas in unit time.

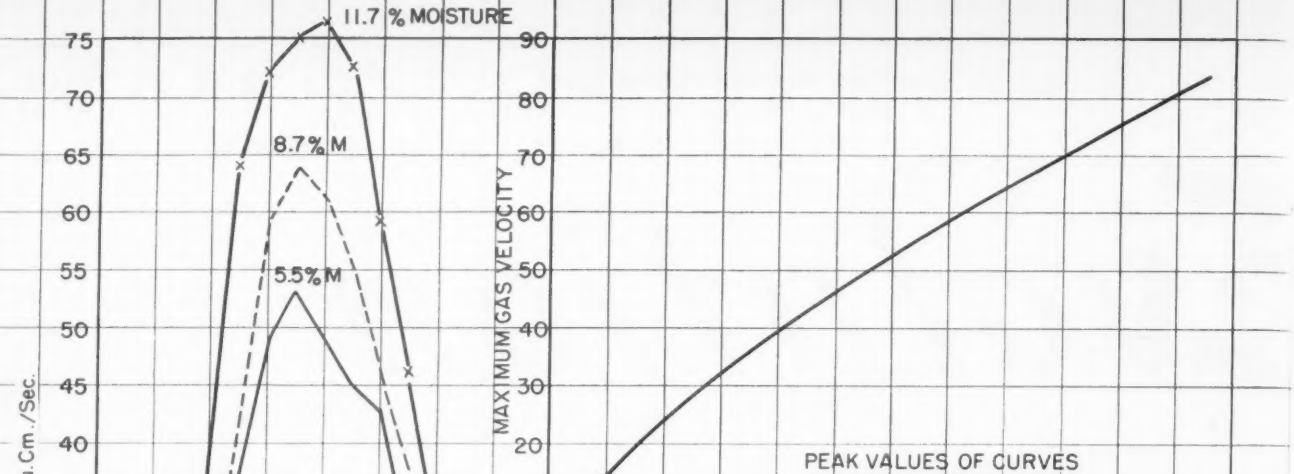
Experimental Procedure — The whole procedure was based on a desire to duplicate practical conditions as nearly as possible. The apparatus chosen was simply a standard orifice, the rate of gas flow being measured by taking readings of the back pressure caused by inserting the orifice in the stream of gas.

The general arrangement of the apparatus finally decided on after several preliminary experiments is shown in Figs. 1 and 2. Fig. 2 shows the details. Three test cores of the sand to be tested are rammed in the double compression rammer shown and then baked if necessary. They measure ¾-in. diameter by 2-in. long and are placed in a ¾-in. pipe 12 in. long. They are held in position in the center of the pipe by the coil springs shown. The pipe is threaded on both ends and given a 1500° F anneal to remove oil and materials likely to give gas during the test. Galvanized pipes should not be used unless all the zinc is removed by annealing at a good red heat.

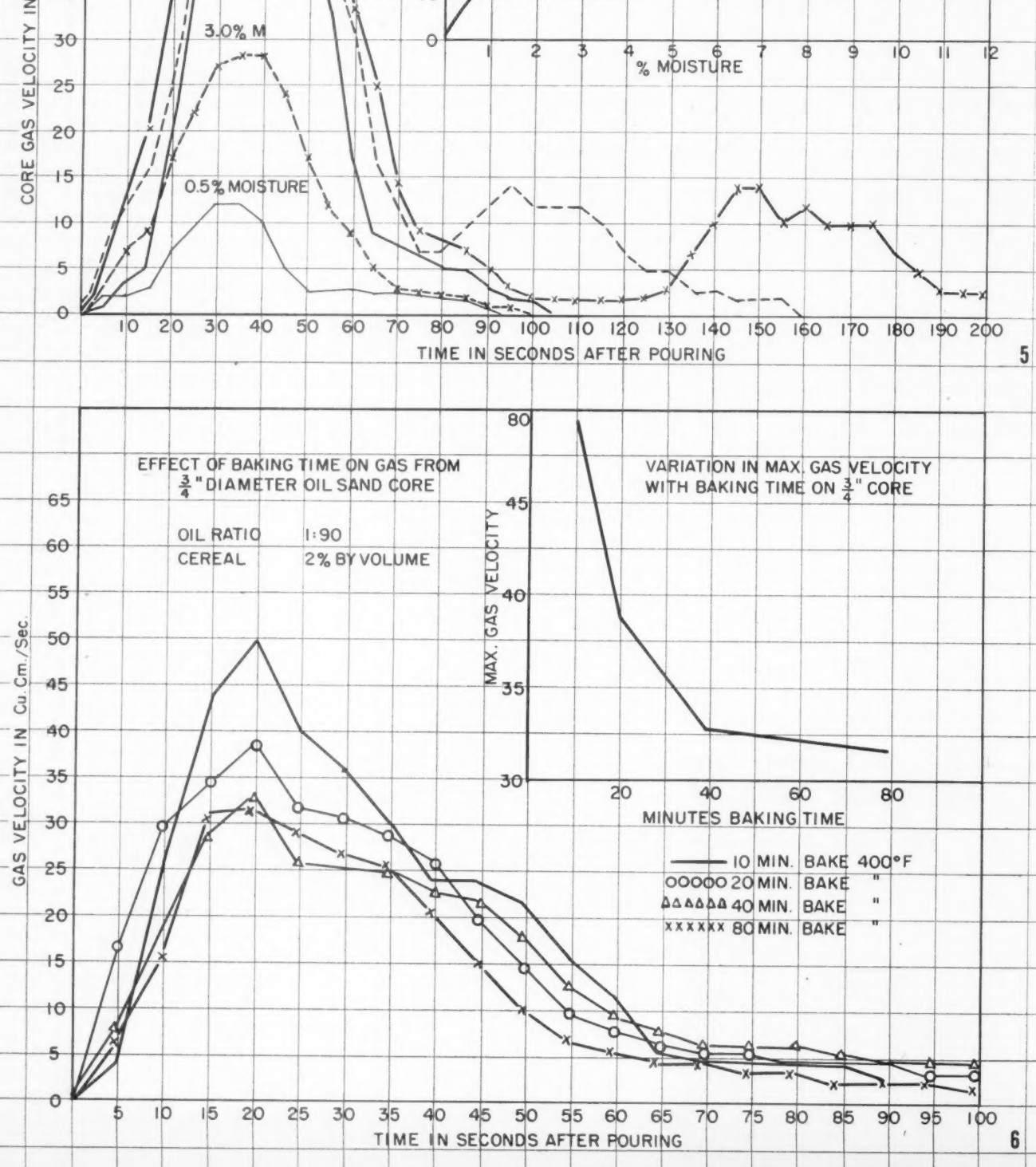
The pipe containing the test specimens is placed in the mold core shown and held in position by pasting stop-off cores into the mold core. One end of the pipe is plugged with a ¾-in. coupling and plug and the

Fig. 4—Calibration curve employed gives relationship between orifice back pressure and gas flow




11.7 % MOISTURE
8.7% M
5.5% M
3.0% M
0.5% MOISTURE
CORE GAS VELOCITY IN Cu.Cm./Sec.
TIME IN SECONDS AFTER POURING
MAXIMUM GAS VELOCITY
% MOISTURE
PEAK VALUES OF CURVES
AT LEFT PLOTTED HERE

5


EFFECT OF BAKING TIME ON GAS FROM
¾" DIAMETER OIL SAND CORE
OIL RATIO 1:90
CEREAL 2% BY VOLUME
GAS VELOCITY IN Cu.Cm./Sec.
TIME IN SECONDS AFTER POURING
VARIATION IN MAX. GAS VELOCITY
WITH BAKING TIME ON ¾" CORE
MAX. GAS VELOCITY
MINUTES BAKING TIME
10 MIN. BAKE 400°F
20 MIN. BAKE "
40 MIN. BAKE "
80 MIN. BAKE "

6

Gas Evolution

other end is connected by means of a ¾-in. pipe union to the inlet at the base of the cylinder of the measuring apparatus.

The measuring apparatus consists of a 3-in. pipe about 3 ft long with two inlets at the bottom end and one outlet at the top. A standard orifice as used in the usual permeability meter is screwed into an adaptor at the extreme end of the outlet pipe, and a suitable manometer filled with colored water is connected to the outlet just below the orifice.

The apparatus is first calibrated by passing known amounts of air through the orifice and measuring the pressure on the orifice. This is accomplished by connecting one of the bottom inlets through a valve to a water supply and running the water at different rates for a 10-second period.

The calibration curve obtained with a 0.5 min. orifice is shown in Fig. 4 and enables the gas velocity through the orifice to be determined by making a reading on the manometer in inches water gage.

In actual test, metal is poured around the pipe in the mold core and readings are taken on the manometer every five seconds from the time that the metal first hits the pipe. Pouring is continued until the mold is full, when the pipe is surrounded by a metal block 6 x 5 x 5 in. deep. The pressure readings obtained are converted to cu cm of gas per second by using the calibration chart already referred to.

Several different binders were tested by this method; in general, the results confirmed the lab tests measuring the total volume of gas which was discussed previously. Considerable difficulty, however, was experienced with pitch and pitch compounds in that they tended to clog up the orifice with tar during the test, thus making an accurate reading almost impossible.

To overcome this difficulty, the apparatus was changed somewhat according to Fig. 3. In this case the orifice consists of a sand body rammed in a ¾-in. pipe. Once again, this orifice is calibrated by passing known quantities of air at different rates.

As moisture is the first and foremost binding material used in a foundry, the gas generated by varying amounts of moisture was measured. A base mixture of Port Crescent silica sand with 10 per cent of bentonite to carry a high moisture content was used and the results are shown in Fig. 5. The left-hand curves show the gas velocity at 5 second intervals after casting at zero time. The peak velocity is obtained 30 to 40 seconds after the molten iron touches the test pipe and then falls rapidly to amounts too small to measure within 100 seconds after casting. In the case of high moisture, however, 8.7 per cent

Fig. 5—Showing how gas velocity varies with the change in moisture content of a sand mixture
Fig. 6—Results of tests to determine effect of baking on an oil sand core. This indicates how underbaking results in a higher gas evolution

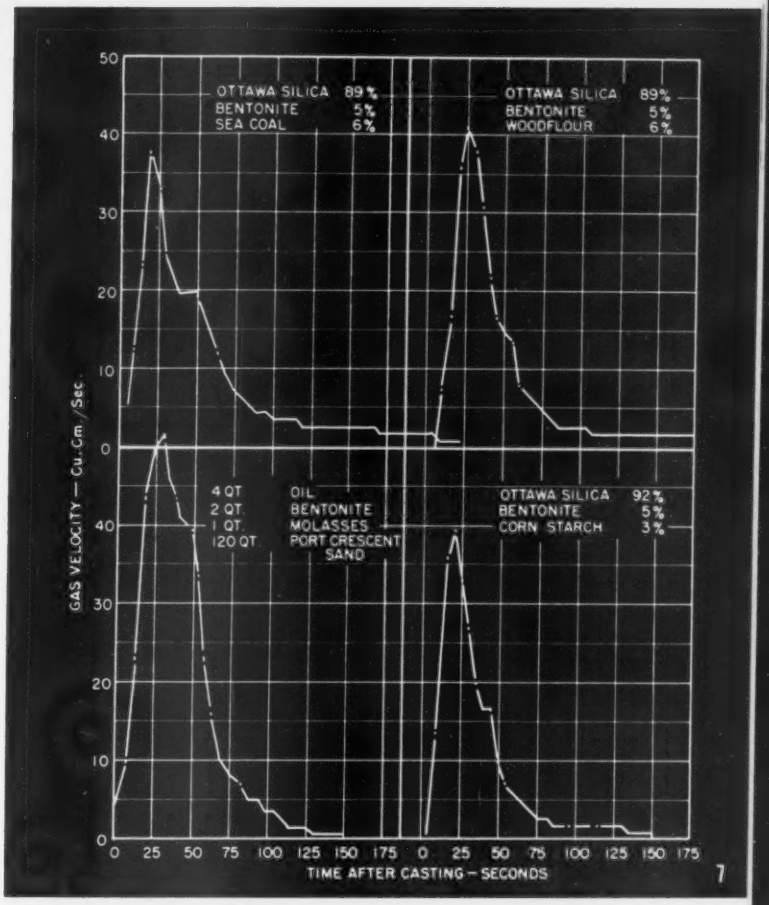

OTTAWA SILICA 89%
BENTONITE 5%
SEA COAL 6%
OTTAWA SILICA 89%
BENTONITE 5%
WOODFLOUR 6%
4 QT. OIL
2 QT. BENTONITE
1 QT. MOLASSES
120 QT. PORT CRESCENT SAND
OTTAWA SILICA 92%
BENTONITE 5%
CORN STARCH 3%
GAS VELOCITY — Cu. Cm. / Sec.
TIME AFTER CASTING — SECONDS
0 25 50 75 100 125 150 175 0 25 50 75 100 125 150 175
0 10 20 30 40 50
7

Fig. 7—Gas velocities resulting from 5 per cent addition of various type binders to the sand

and 11.7 per cent—a secondary peak value is obtined. This secondary peak is probably associated with condensation of initially developed steam in the cold regions of the core followed by regenerating as the heat progresses inwards to the center of the core.

On the right-hand side of Fig. 5, the peak values are plotted against the moisture content. It can be seen that the velocity of the gas or steam generated is proportional to the amount of moisture in the sand. Each 1 per cent extra moisture results in an approximate pressure increase of 1½ in. of water at a permeability of 50 in the orifice. When it is considered that increased moisture also leads to a lower permeability in the sand, it is not difficult to see why increased moisture often results in defects attributable to steam pressure in the mold.

In Fig. 7, the gas velocities due to 5 per cent of various binders are shown. The same results, together with maximum gas velocities for other binders, are shown below.

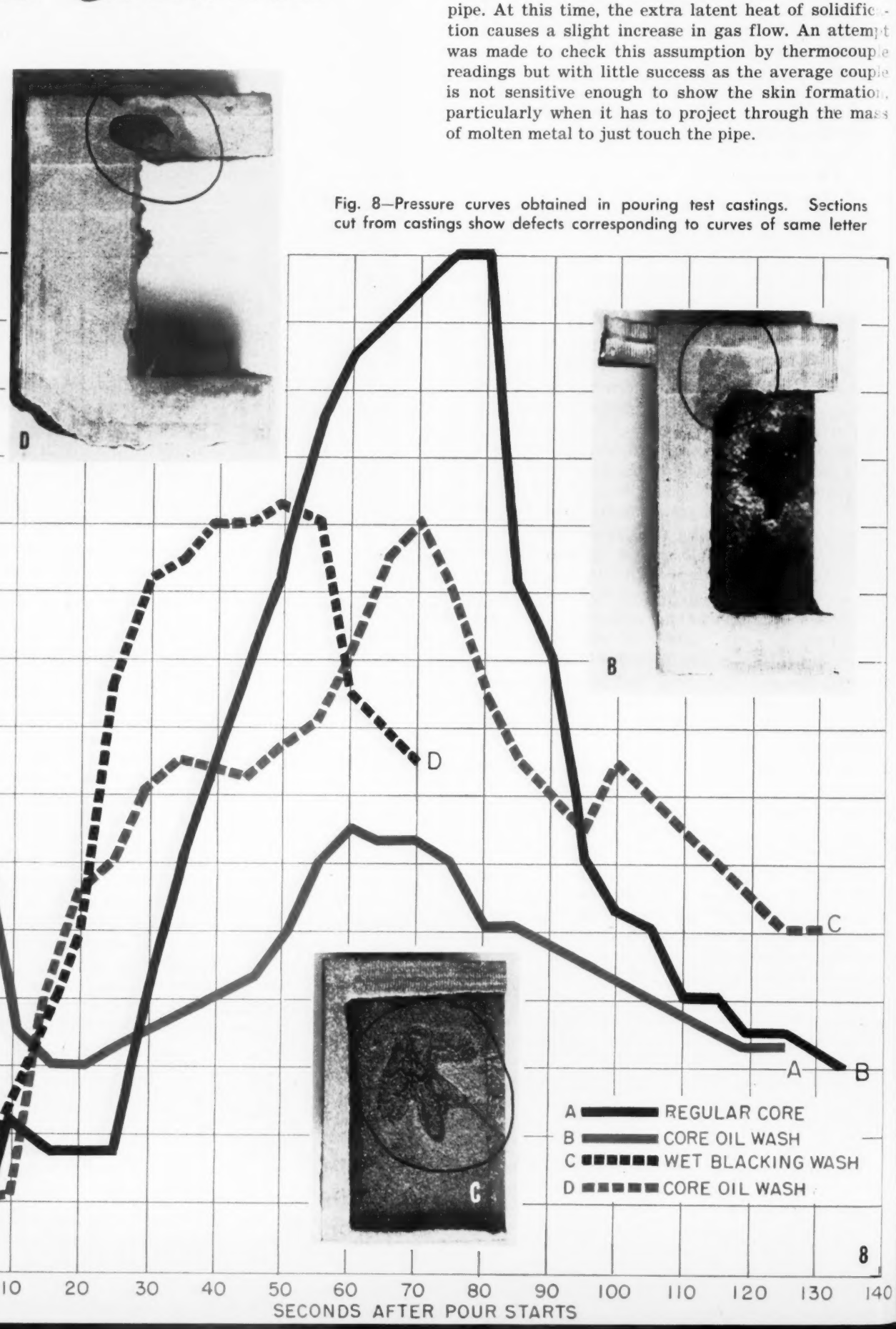
6% Gilsonite binder	30 cu cm
6% Pitch binder	43
6% Seacoal	36
3% Cereal starch	40
6% Wood flour	42
5% Moisture	46
3% Oil and 1% molasses	54

In general, the different curves obtained follow each other very closely in form. There is an initial

Gas Evolution

peak value at about 30 seconds followed by a fairly rapid drop in pressure. Nearly all curves show evidence of an arrest point at about 40-50 seconds after casting. It is thought that this arrest represents the initial solidification or skin formation around the pipe. At this time, the extra latent heat of solidification causes a slight increase in gas flow. An attempt was made to check this assumption by thermocouple readings but with little success as the average couple is not sensitive enough to show the skin formation, particularly when it has to project through the mass of molten metal to just touch the pipe.

Fig. 8—Pressure curves obtained in pouring test castings. Sections cut from castings show defects corresponding to curves of same letter



As in the case of the high moisture content sands, this arrest point may be associated with condensation and heat flow through the test core, although the fact that it occurs in all binders, regardless of the type and amount, rather lends support to the skin solidification theory. In the curves shown in Fig. 7 it should be noticed that the oil sand tested gives quite a high rate of gas flow compared with the dry binders, and 3 per cent corn starch gives more gas than 5 per cent seacoal.

A series of tests were run to determine the effect of baking on an oil sand core. The results obtained are shown in Fig. 6. It is apparent that underbaking gives a higher gas evolution. In going from a 10-minute bake to a 40-minute bake there is a drop of roughly 34 per cent in the amount of gas evolved. This in practice may well mean the difference between success and failure.

It has been shown that gas evolved from a sand mix is given off at a definite volume rate which varies with time and also that the resistance pressures involved are not extremely high. A practical test was now conducted to see if a blowhole could be produced at will in a test casting.

The casting shape chosen was as indicated in Fig. 9. A metal tube was placed inside the core to measure the pressure developed during casting. The core pressure was varied over a range by painting the core surface with core oil and by using a wet blacking wash. The pressure curves obtained are shown in Fig. 8.

The highest pressure obtained was 15 in. water gage with a core which had been saturated with core oil (curve No. B). A similar core in curve No. D had a lighter washing of core oil. In these castings, blows were expected and should have been obtained with any pressure exceeding 7 in. water gage. In Fig. 8, sections cut from the various castings show a trace of disturbance in No. B which corresponds to curve No. B. A defect typical of wet washes is shown in No. C which corresponds to curve No. C.

As blows were not obtained despite the high pressures recorded, the conclusion was reached that the casting solidified before a pressure high enough to cause a blow was reached. Accordingly, the casting section was increased from $\frac{3}{8}$-in. to $\frac{3}{4}$-in. in order to prolong the solidification and allow a high pressure to be reached before solidification. The core was painted with oil and gave the curve No. D.

No. D casting in Fig. 8 shows the blowhole obtained at the upper part of the core where the $\frac{3}{4}$-in. section joins the $\frac{3}{8}$-in. section.

It is apparent, therefore, that for a blowhole to occur, there must be a pressure in the core which is high enough while the iron is still in a liquid or semi-liquid condition. High pressures after solidification can do no harm.

It is interesting to note from the curves that the peak value due to air displacement from the mold—that is, the initial peak value—varies considerably. In curve No. A it is very pronounced; the core has no wash and allows rapid elimination of displaced air. The blacking wash in curve No. C gives a very low initial peak at 10 seconds, showing the resistance to air flow from the mold. Coating the cores with oil as in B and D also retards air flow from the mold.

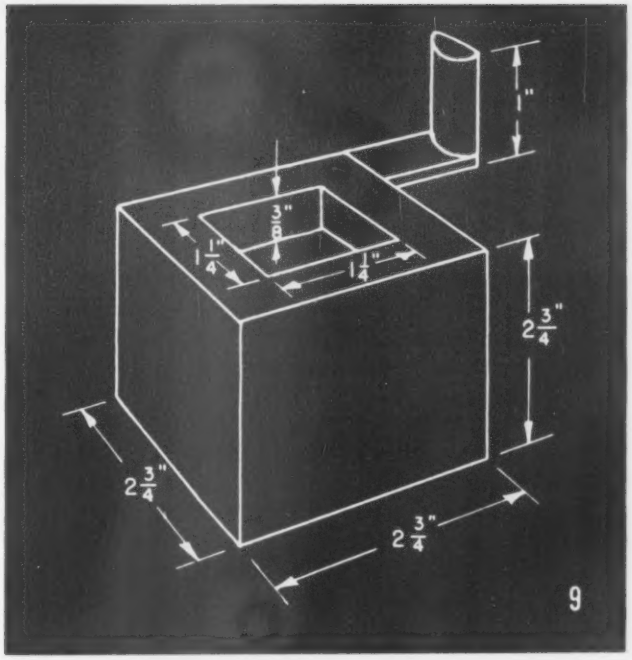


Fig. 9—Type of test casting poured in measuring pressure in cube core at center. Sprue height 1-in.

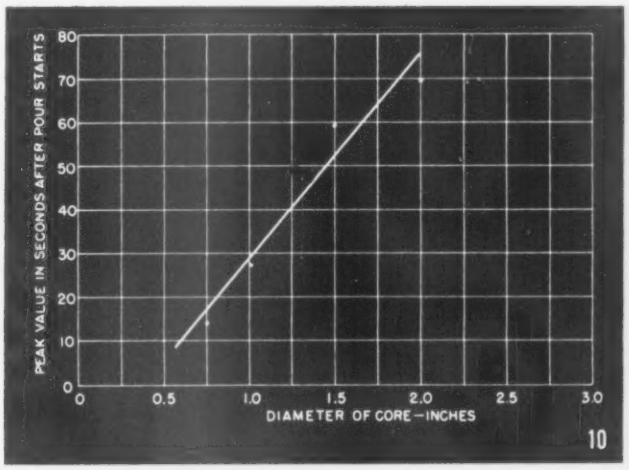


Fig. 10—Variation in time required to reach peak in gas pressure with cores of different diameters

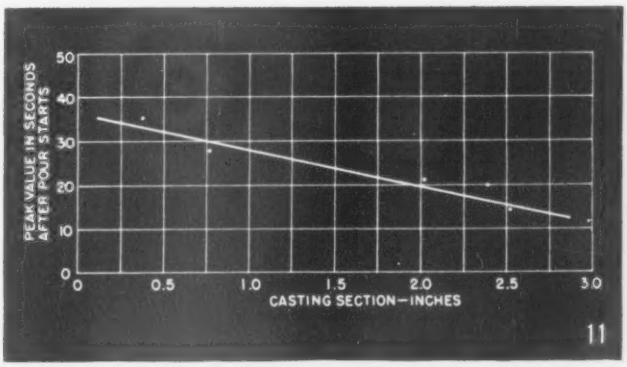


Fig. 11—Showing how time to reach peak value varies with casting section around $\frac{3}{4}$-in. core

Gas Evolution

Because the free air flow from the mold as in curve No. A results in core pressure of 6 in. water, it can be assumed that the pressure against the iron entering the mold may be of the same order. This has a considerable bearing on misruns in molds where no provision is made to remove displaced air. The air will not go through a core because it is blackened or through a mold that is blackened. A flow off or vent on molds of this nature is good insurance.

It should be noticed that the peak values obtained in the test at 70 seconds after casting, except where the section was heavier and the peak was obtained in 55 seconds. This peak value can be expected to vary according to the thickness of the core and to a more limited extent to the surrounding metal section or, more correctly, the surrounding heat effect on the core.

By casting varying metal sections around varying thickness of core and observing the time to obtain the peak value, the ratios indicated in Figs. 10-11 were obtained. These values were obtained with round cores because of the relative ease of inserting a pressure pipe in these cores and should be regarded only as indicating a trend. The actual peak value will depend on the exact conditions present in any mold or core and will probably vary principally with:

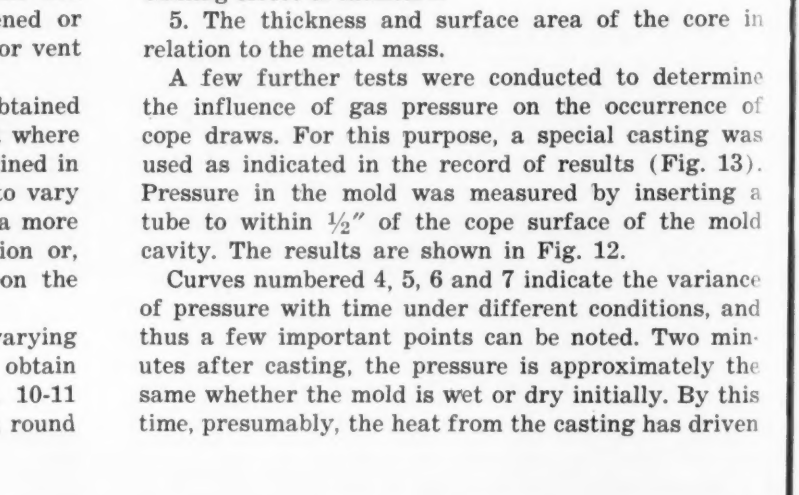
1. The mass surrounding the core and the specific heat of the metal.
2. The thermal conductivity and heat absorption of the core.
3. The amount of preheat obtained as the mold pouring rate is varied.
4. The heat insulating effects of a core wash or chilling effect of moisture.
5. The thickness and surface area of the core in relation to the metal mass.

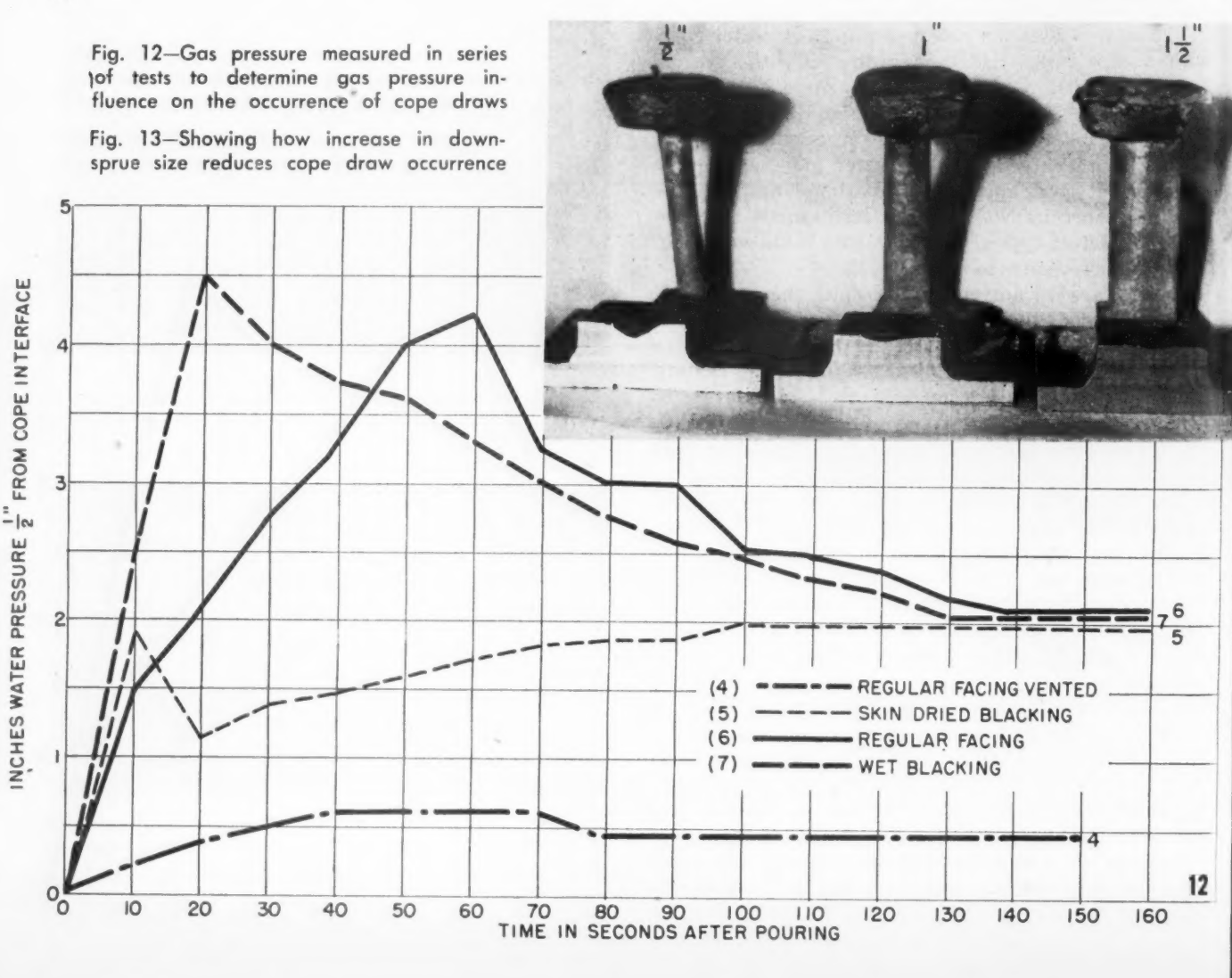
A few further tests were conducted to determine the influence of gas pressure on the occurrence of cope draws. For this purpose, a special casting was used as indicated in the record of results (Fig. 13). Pressure in the mold was measured by inserting a tube to within ½" of the cope surface of the mold cavity. The results are shown in Fig. 12.

Curves numbered 4, 5, 6 and 7 indicate the variance of pressure with time under different conditions, and thus a few important points can be noted. Two minutes after casting, the pressure is approximately the same whether the mold is wet or dry initially. By this time, presumably, the heat from the casting has driven

Fig. 12—Gas pressure measured in series of tests to determine gas pressure influence on the occurrence of cope draws

Fig. 13—Showing how increase in downsprue size reduces cope draw occurrence





off the excess moisture. The importance of this will depend entirely on the casting section. If the section is heavy, solidification is likely to occur at a later time when the effects of heavy moisture have worn off, whereas if the section is light and solidification is rapid, extra moisture may cause a lot of trouble. This does not mean that one can be careless of the moisture content in heavier section castings as it has been shown that a high moisture content may lead to sand burn-on. It does mean, however, that the lighter the casting section the more important it becomes to keep moisture under control and pour with good hot metal so that the maximum pressure may decrease before solidification begins.

The effect of venting the cope is well brought out in curve No. 4, where the pressure has never gone above ¾-in. of water as against 4½-in. pressure in a wet mold and a 4¼-in. pressure in a regular mold without any vents. The degree of cope draws found in these castings was approximately equal, but with the vented mold the cope draw was very slight and considerably less than in the other castings.

The initial peak values shown on the curves are due to the first rush of displaced air through the sand. The peak occurs at about the time the metal hits the cope pocket. This is to be expected as no provision was made by venting or risering for the displaced air to leave the mold. In one case, where the mold was rammed extremely hard and very hot metal was poured, the iron chilled up at the gates and the casting was misrun. This was attributed to the high pressure developed through the inability of the air in the mold cavity to leave the mold, and this is a factor that must always be borne in mind in squeezer work which is not vented or has no flow-off. Misruns can occur even with perfectly hot metal. Do not always blame the metal; blame the inability of the sand to take a hard ram.

Continuing the investigation on the occurrence of a cope draw in this casting, a series of castings were made with different size downsprues, the idea being to prolong the fluid pressure of the iron against the cope so that the effect of gas pressure from the cope would be nullified. The results obtained are shown in the sectioned castings of Fig. 13. It can be seen that as the size of the sprue is increased from ½-in. to 1½-in., the size of the cope draw is decreased. Thus, the 1½-in. sprue is almost free from a draw, whereas the 1-in. sprue in the center has a slight draw.

In Fig. 14 the effect of venting is shown. The vented casting shown on the left has less draw than the unvented one at the right. In these castings a ½-in. donwsprue was used. When using both vents and a ⅞-in. downsprue, the cope draw was entirely eliminated.

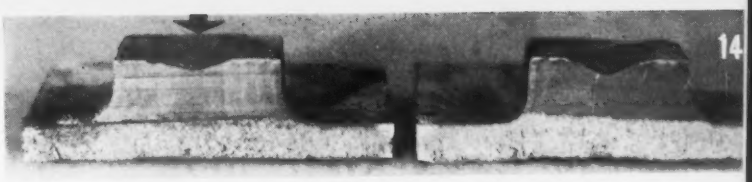


Fig. 14—Effect of venting on presence of cope draw. Cope of the casting at left was vented

Summary and Conclusions

1. A relatively simple method of measuring the amount of gas from any sand mix has been described. The measurement concerns itself with rate of gas flow expressed as cubic centimeters per second rather than with the total volume of gas generated. The test samples used are three cores each ¾-in. in diameter and 2-in. long having a total surface area of 14.2 sq in. This enables gas velocity to be expressed as cubic centimeters per second per square inch. The most reliable method consists in using a sand orifice which has been previously calibrated. This method is not subject to inaccuracies caused by orifice plugging during a test.

2. In expressing the gas evolution, the maximum or peak value has been taken for comparison between various binders. If this peak value can be taken care of during casting, very little trouble can be expected.

3. Gas evolution, in general, follows a very definite pattern. There is a rapid rise in gas velocity to a peak value, followed first by a rapid fall and then by a gradual fall in velocity. The time of occurrence of this peak value will depend on several factors, among which are the size of the sand body and the section of the metal adjacent to the sand body.

4. In making pressure measurements in molds and cores, the importance of the rush of displaced air from the mold cavity has manifested itself. Failure to allow for escape of this air may easily result in a misrun casting.

5. The importance of moisture content as a gas former has been clearly shown. With moisture and with other binders the gas evolved is directly proportional to the amount in the sand.

6. It has been shown that underbaking of an oil sand core leads to a greater gas evolution. This is particularly troublesome where the surface of the core is green. Applying a core oil wash to the surface in contact with metal will lead to a tremendously increased gas evolution.

7. In view of the complexity of the fluid pressure problem it is difficult to know when a resistance pressure is high enough to cause a casting defect. A pressure which is too low to cause a blow while the metal is still liquid may yet be sufficient to cause a blow while the metal is partly solidifying with a decrease in fluid pressure. The time at which a casting skin forms is of prime importance, and it has been shown that even with extremely high resistance pressure a blow will not form until the solidification is prolonged by an increase in metal section, so that the pressure is excessive while the iron is in a semi-solid condition. Should the pressure be high while the iron is still liquid, it will relieve itself by gas bubbling through the liquid. This is always what is happening when we observe a blow during or immediately after casting.

8. There is a definite relationship between the occurrence of a cope draw and mold back pressure. The extent of the draw may be decreased by venting the cope, thus lowering the resistance pressure, or by increasing the downsprue and ingates, thereby holding the ferrostatic pressure for a longer period. The advantages of using a sand with a low gas evolution and one capable of hard ramming without much decrease in ventability are apparent.

By JAMES G. DICK
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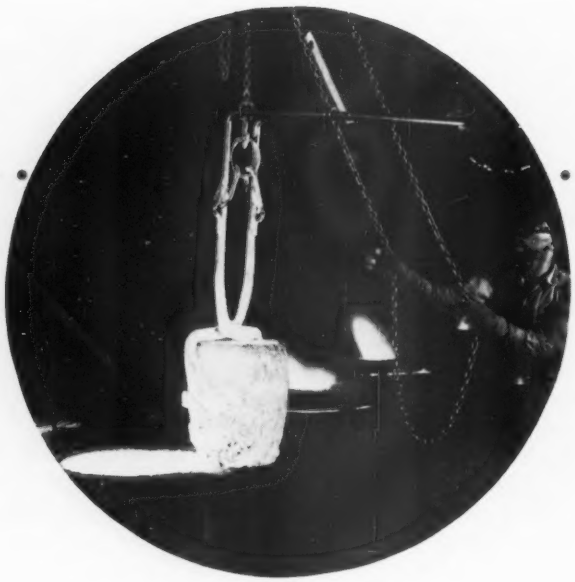
Canadian Bronze Co. Ltd.
Montreal

Melting B



Recommended practice in melting copper-base alloys is discussed by the author in this paper presented at the All Canadian Foundry Conference, Hamilton, Ont., Sept. 29, 1950

IN REVIEWING melting operations of the brass and bronze casting industry one is struck by the variety of melting units used, as well as by the multiplicity of melting procedures recommended and used by those employing any given type of melting unit. Much of the existing melting equipment is of types which can yield melts of good quality only with the application of constant supervision. Even with close operating control, gas-free melts are by no means obtained consistently.

In some cases modern devices have been attached to old melting units to secure more reliable operations. These devices are the practical outlines of the discoveries of the last 10 or 15 years in investigating the causes of and the remedies for gassing in brass or bronze melts. In other cases the old, unreliable types of melting units have been retained and melt degassing procedures introduced to offset poor melt quality. In general the brass and bronze casting industry has been rather slow to adopt melting units and devices capable of yielding consistently melts of good quality.

Under modern conditions brass and bronze castings must measure up in performance and in appearance to forgings, stampings and die castings. In addition, severe competition from other alloys in the ferrous and nonferrous fields must be met and overcome. Wherever a casting exhibits unsoundness due to macroporosity or microporosity, a large proportion of which defects can be attributed to poor melting conditions, this inflicts serious damage on the reputation of brass or bronze castings and on that of the industry in general.

An efficient melting unit and an efficient melting procedure are essential to produce sound castings. The efficiency of any melting furnace centers on its ability to provide consistently, with a careful operating procedure, melts free from gases or other substances capable of causing unsoundness in the resulting castings. Such circumstances as mold moisture, moist atmospheres, damp ladle linings, etc., can gas the melt after its removal from the furnace, but this has no bearing on the matter of melting brass or bronze alloys. So far as the furnace operation alone is concerned, the ability to provide gas-free melts will depend largely on the nature of the charge, conditions of the furnace lining and the type of atmosphere prevailing in the furnace during the melting cycle. It may be well at this point to recapitulate the facts that are known concerning the mechanism of the gassing of brass and bronze melts.

It has been established during the last ten or fifteen years that the most dangerous gas, from the standpoint of causing unsoundness in brass or bronze castings, is hydrogen. Three characteristics of hydrogen are responsible for this: Its comparatively high solubility in molten copper-base alloys, increasing with increasing temperature; its relatively low solubility in copper-base alloys in their solid state, and its marked ability to combine, at high temperatures, with certain metallic oxides to produce water vapor.

Hydrogen available for absorption during the melting cycle may originate from a number of different sources. The most important of these sources are:

1. Hydrogen gas as the element itself, originating as a product of the incomplete combustion of hydrocarbon fuels such as gas or oil.

2. Hydrogen gas produced indirectly in the furnace by the break-down at furnace operating temperatures of water vapor. The source of water vapor may be the normal content of the atmosphere, the water vapor produced as a normal product of the combustion of hydrocarbon fuels, the water vapor expelled

Brass and Bronze

at elevated temperatures from poorly dried furnace linings or that originating from moist metal charges.

3. Hydrogen gas produced indirectly in the furnace by the reducing action at furnace operating temperatures of carbon or carbon monoxide on water vapor. The source of carbon or carbon monoxide may be the incomplete combustion of hydrocarbon fuels, the combustion of solid fuels such as coke, the combustion of oil, grease or other carbonaceous substances contaminating the metal charge, the partial combustion of a graphite crucible, the combustion of a charcoal cover over the charge or, in the case of electric arc furnaces, the result of poor arcing conditions. The source of water vapor may be any one or a combination of those mentioned under No. 2.

Hydrogen gas, once dissolved in the melt, may cause unsoundness in the derived castings in two different ways. First, with certain alloys and under certain melting conditions hydrogen gas will be expelled during cooling and solidification of the metal in the mold, because hydrogen solubility decreases with decreasing temperature. The liberated gas, if unable to escape from the mold, will cause generalized porosity. The type of porosity may vary from very large gas holes to fine microporosity, the size of the gas holes being dependent on the quantity of hydrogen originally absorbed by the melt and on the rate of cooling of the casting.

The second way in which hydrogen gas can cause unsoundness involves the formation of a hydrogen compound. With certain alloys and under certain melting conditions absorbed hydrogen gas will react, during the cooling and solidification cycle, with metallic oxides such as cupric oxide dissolved in the melt. Such a reaction will produce water vapor and this product, if unable to escape from the mold, will cause generalized porosity. Here the size of the gas holes will depend upon the amount of hydrogen absorbed, the quantity of metallic oxides available for reaction and the rate of cooling of the casting. In the main, therefore, whether or not hydrogen gas will be absorbed and retained by a melt will depend on the nature of the furnace atmosphere during the melting cycle. The existing atmosphere will, of course, be a function of the type of melting unit and melting procedure used.

Proper control of the many variables in brass and bronze melting is essential if good quality melts are to be obtained consistently. Of these variables a few are important only in connection with some specific melting unit type; others are of more general importance and must be closely controlled regardless of the type of melting unit. These variables and their relationship to various furnace types will be outlined.

The Charge—The charge itself falls into the category of variables of a general nature. Individual items comprising the charge must be treated prior to charging, wherever necessary, to remove all residual moisture, grease, oil or other carbonaceous substances. Such contaminants can liberate water vapor, carbon monoxide and carbon at elevated temperatures. All of these compounds, by thermal breakdown and by chemical inter-reaction, increase the amount of hydrogen gas available for absorption during the melting cycle. The fact that they are liberated in close proximity to the charge itself only increases the possibility that hydrogen absorption will take place.

The method of charging should permit rapid melting with low melting losses. This applies to all types of furnaces, but particularly to gas or oil fired crucible or reverberatory furnaces, since with these types melting losses will definitely be influenced by the charging technique. In all instances the furnace or crucible should be preheated to a bright red heat before charging. This helps to reduce the heating and melting period, thereby assisting in lowering the possibility of excessive hydrogen absorption by the charge or melt. Since brass or bronze alloys will start to absorb gases, even while in the solid state, at temperatures in excess of approximately 1200°F, no portion of the charge should be preheated to red heat before charging. A gentle preheat does no harm, and indeed may assist in reducing the melting period and in eliminating condensation moisture, but the preheat temperature must never be permitted to approach red heat.

The heavier portions of the charge, such as ingots or large scrap castings, should always be charged first and melted down. To the pool of molten metal thus obtained the lighter portions of the charge, such as turnings or small scrap castings, should then be added. This procedure creates three important conditions. First, it permits a more rapid melting cycle and therefore less time for hydrogen absorption. Second, it prevents turnings or light scrap, which have a relatively large surface area per unit weight, from being held for a long period at red heat prior to melting down. Since (*Please turn to page* 153)

FOUNDRY Operating P

Before present-day foundry mechanization, workers considered themselves practitioners of a mysterious art. The pride of work was evident in their products

PRIOR to the high degree of mechanization that exists in numerous foundries today, most foundry workers considered themselves to be practicioners of a mysterious art. As such they prided themselves in their knowledge of the secrets of the art of founding, and took every precaution necessary to produce good castings lest their fellow workers should look upon them with disdain.

The melter saw to it that his raw materials were carefully segregated and that all components of the charge were carefully measured either by weight or by volume. He repaired and operated his furnaces as if they were the most delicate and sensitive melting units known to mankind. And when he delivered the metal to a molding section he was proud of his creation and of the private procedures by which he had produced it.

The molder conditioned his own sand until its properties were perfect according to his private standards. He rammed a mold in such a manner that he was satisfied it was far too good to be filled with the earthly metal supplied by the melter. However, he would condescend to pour the unfit metal into his perfect mold according to his personal procedures established from years of experience. After the casting had solidified, the molder would shake it out with all the care and knowledge at his command, proud that he had made the best casting of which he was capable.

With mechanization, a considerable degree of personal pride in the finished casting was lost by most of the foundry workers. Also, as new employees took over the machines, a goodly portion of the old timer's secrets were forgotten or ignored. It was sometimes difficult for a man on a mechanized line to fully realize how important his particular assignment was in producing a quality finished product. In addition, where two or more crews operated the same line at different times, procedures were very likely to vary as much as the personalities involved. All of these factors contributed to the production of scrap rather than the works of art of which the old timers were so justifiably proud.

In an effort to overcome these particular problems of mechanization in the Westinghouse Electric Corp. gray iron foundry at Trafford, Pa., it was decided to establish Operating Procedure Standards. First a rough draft of a standard was drawn up and discussed with concerned supervisors and foundry engineers. After they had agreed upon the procedure it was discussed with the workmen who would have to observe it. Their frank constructive criticism was sincerely asked for and received. Finally, with all comments and criticisms having been given full consideration, the finished draft of the Operating Procedure Standard was submitted for approval and actual practice.

With widespread application of mechanization, a considerable degree of personal pride in the finished casting was lost by most of the foundry workers

Copies of the procedure were posted in prominent and easily accessible locations throughout the department or departments involved. It was not intended for the procedures to cover every minute detail of molding or melting, but rather to establish standards for the more important operations involved. The Operating Procedure Standards minimize the variations in methods due to the human element, and also give the individual worker a clearer picture of the importance of the role he plays in producing a quality casting.

Following are excerpts from some of the Operating Procedure Standards now being used at Trafford Foundry:

1. **Care and Cleaning of 10-Ton Holding Furnace**
   a. The exhaust port shall be cleaned whenever necessary. This shall be at least once a shift.
   b. The intake port shall also be cleaned whenever necessary.
   c. Poor draft and excessive pressure inside the furnace shall be the determining factors as to the cleaning of the exhaust and intake ports.

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Procedure Standards

d. The furnace shall be slagged completely at least once every shift.

e. The pouring and intake spouts shall be kept as free as possible of excessive solidified slag and metal.

f. Efficient furnace operation, especially from an iron quality standpoint, is directly proportional to how well the intake and exhaust ports are kept clean and how well the furnace is slagged off.

2. Cupola Charging System

a. Charging system operator shall be thoroughly familiarized with current charge components. This shall be a responsibility of the manufacturing engineer assigned to section TF-49.

b. Material being charged into the weight hopper shall not exceed 33 in. in length or 100 lb in weight.

c. Maximum allowable errors in materials being charged.

1. Pig Iron	50 lb + or −
2. Bought Scrap	25 lb + or −
3. Home Scrap	25 lb + or −
4. Steel Scrap	30 lb + or −
5. Total Metallics	25 lb + or −
6. Coke	15 lb + or −
7. Limestone	5 lb + or −

Charging system operator will make hand adjustments when necessary to stay within the limits of these errors.

d. Absolutely no change will be made in the charge without consulting the manufacturing engineer and the foreman in charge of section TF-49.

e. The charging level of the cupola if at all possible shall not be allowed to drop lower than two charges.

3. Refractory Maintenance on Detroit Arc Furnace

a. Wash the electrode ports with alundum or other cement when required to maintain a snug electrode fit.

b. Coat the surfaces around the door opening daily with a slurry of refractory cement.

c. Remove any slag from the lining inner surface or the furnace hearth. This is best accomplished when the furnace is hot.

d. Patch any worn or broken spots using a high-temperature patching cement of same type as the lining itself. Be certain that all surfaces to be patched are free from slag. Surface patches are frequently ineffective. Deep patch when possible, keying the patches in place thoroughly.

4. Checking of Molding Equipment and Records

a. All high-scrap jobs will be marked as such in the activity file by the manufacturing engineer.

b. If the activity file indicates a high scrap percentage, the production department will mark the order card with the symbol Hi Sx.

c. Checker will notify the foreman of all order cards marked Hi Sx.

d. The foreman will consult the group leader, engineer and inspector on the elimination of defects.

e. All pattern equipment must be inspected by the molder or group leader. If the pattern, pins or gate are in any way defective, the group leader will not make the molds unless ordered to do so by the foreman.

f. All patterns will be marked with the correct size chaplets to be used as well as the number of cores.

g. Defective flasks shall not be used. This is a responsibility of the molder and group leader.

h. Prior to ramming a mold the group leader and/or the molder will insure that the pattern is clean and, if necessary, polished.

i. The molder will be responsible for proper placing on the pattern, of the round and slotted holes in the flask. Also for the flask being fully seated on the pattern. Flasks will not be forced on the pattern.

Pride returned when Operating Procedure Standards were drawn up with the assistance of the workers. Now the worker has a clearer picture of the important role he plays to produce a quality casting

Statistical Quality C

Application of statistical quality control methods has been reduced to simple arithmetic, but the plan can be a mighty valuable tool in the foundry. This paper, explaining how it works, was presented by the author at the Technical and Operating Conference of the Steel Founders' Society of America in Cleveland, Nov. 9-11, 1950

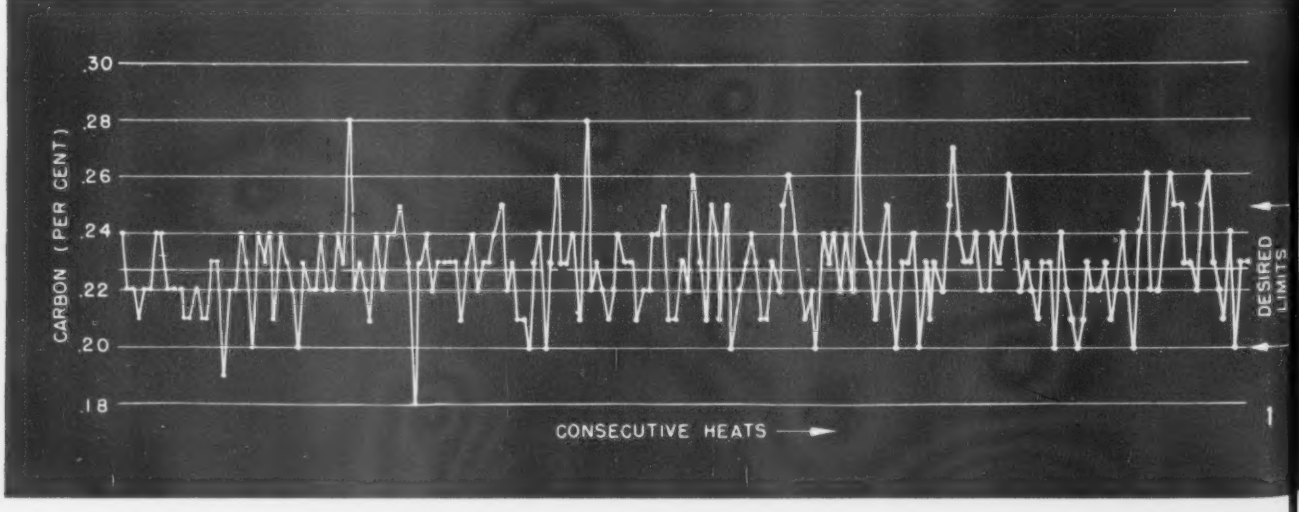
WITHIN the last few years, the use of statistical quality control methods has shown an amazing increase in popularity and many and varied applications have been made of this technique. Perhaps one of the most surprising places to apply it has been in the casting process, yet it has found a fertile and expanding field of application in the foundry industry.

The interest of National Malleable & Steel Castings Co. in this field dates back to the days of World War II, when the "Steel Castings Quality Control Plan" of the Ordnance Department was put into effect and applied to production of cast armor and other steel castings. The plan was based on the mathematical principles by means of which fluctuations in a process can be measured and evaluated. However, the mathematics involved were reduced to simple arithmetic and the principles were so simply defined that the plan was readily understandable and therefore workable. In other words, what had been a tool for the "highbrow" mathematician was simplified to the point where it could be used by men with an ordinary education.

Through application of this plan, our plants were able to very materially reduce the tensile test requirements for certain castings being produced for the Ordnance Department. Not only did this save money because of the smaller number of tests required but, also, because it expedited the flow of material through the shop. Quality standards had to be kept higher than the bare minimum requirements, if the process was to stay "in control." Moreover, a continuous picture of the process was provided so that corrective steps could be taken, usually before the process went "out of control," and this also contributed to economy of operation and to a high level of quality.

With such a background, it was a logical step to attempt to apply this same technique to peacetime production in an attempt to achieve economies in operation and at the same time to secure and maintain a high quality level.

Fig. 1—Carbon content of consecutive steel heats. Values outside desired limits are quickly spotted



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Control

Up to this time the principal use of the control charts has been, as indicated, in the field of measuring the variations and level of tensile properties of the steel. This is an excellent application which shall be discussed in more detail, but it measures the quality of the product after all the work is done on it. A more important application seems to be that of measuring fluctuations in some of the steps in the process so that corrective measures can be taken to maintain the desired uniformity. This, in turn, should lead to greater uniformity in the finished product and to more economical operation.

For example, chemical analyses are made on every heat to be sure that the material meets certain specifications. In addition, it is well recognized that for each grade of steel, the analyses for carbon and manganese should fall within certain limits so that the castings, when given a specified heat treatment, will have certain mechanical properties. We had been content to make these analyses, look them over and, as long as they were within certain limits, file the analysis records and forget them. One day the idea came that here was something that would be good material for control study because in the files were measurements that had been accurately and systematically made and whose control (or lack of it) affected the processing considerably.

As an example of this application, consider the carbon analyses of 200 consecutive heats of grade B steel. These analyses are tabulated in Table I. It will be noted that they lie largely within the range of 0.21 to 0.25, and the average value for the group can be determined as 0.228 per cent carbon. Since the optimum carbon is 0.23 per cent it can be assumed that the process is giving the desired results.

On the other hand, an occasional analysis falls outside this band. To show how often this occurs the values can be encircled on the tabulation or, better yet, the values for consecutive heats can be plotted as in Fig. 1. This gives a picture from which it is easier to estimate the frequency with which certain carbon values are occurring than from merely looking at the tabulation.

Carrying this one step further, a distribution curve can be constructed to show with what frequency each carbon content occurs. The results of this plotting are shown in Fig. 2. If the distribution was exactly "normal," a bell-shaped curve, symmetrical about a central axis would best represent the distribution. However, in practice one seldom encounters ideal or perfectly controlled conditions; the present example is no exception. Therefore, the curve will have an average axis a little to one side of that for the perfect distribution and the curve itself will be distorted or "skewed" one way or the other.

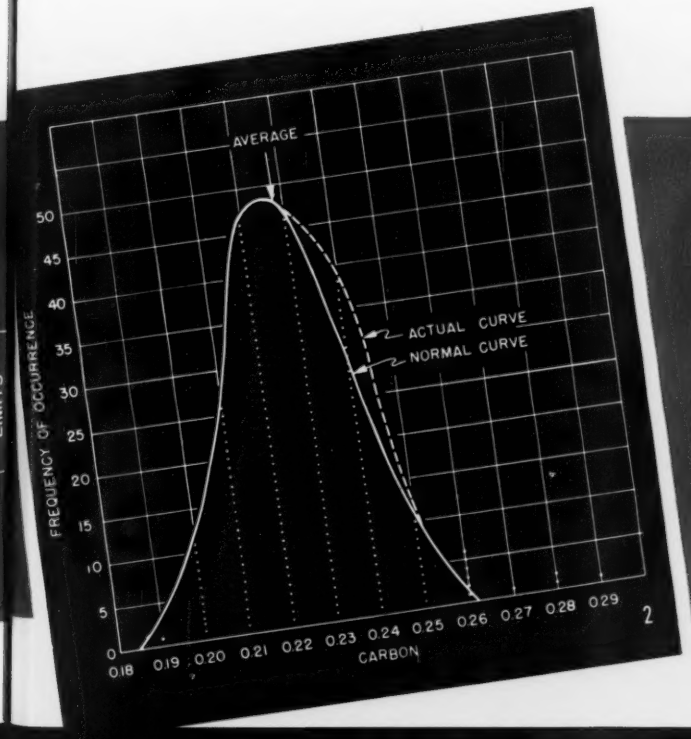
Tne total spread or width of the curve will also vary, depending on the degree of control of the process, and this spread is measured by the statistical yardstick called "standard deviation" and designated by the Greek letter "sigma" (σ).

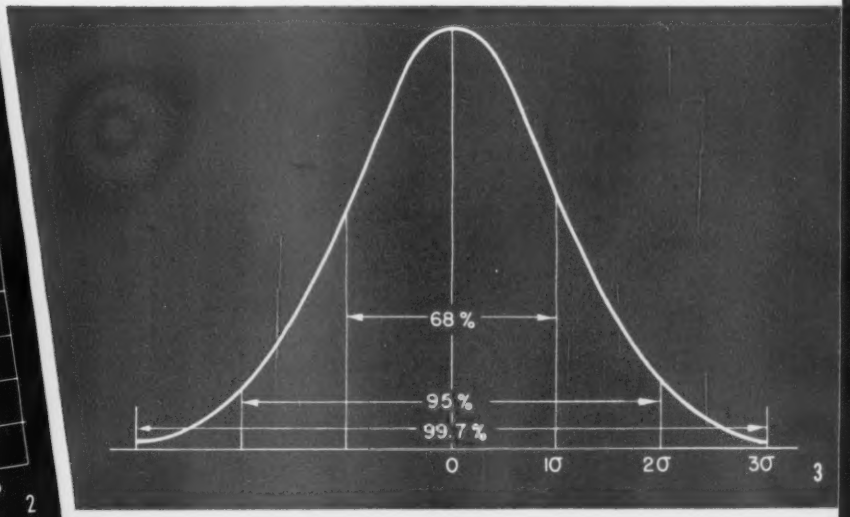
The calculation of the value of sigma is not particularly complicated but, if many measurements are involved, becomes somewhat time-consuming.

It has been found that a frequency distribution can be divided into six zones, mathematically equal in width, as shown in Fig. 3. Three lie on each side of

Fig. 2—Distribution curve showing frequency of occurrence of various carbon contents in heats

Fig. 3—Frequency distribution curve divided into six zones. In a normal distribution 99.7 per cent of the values fall within these six zones





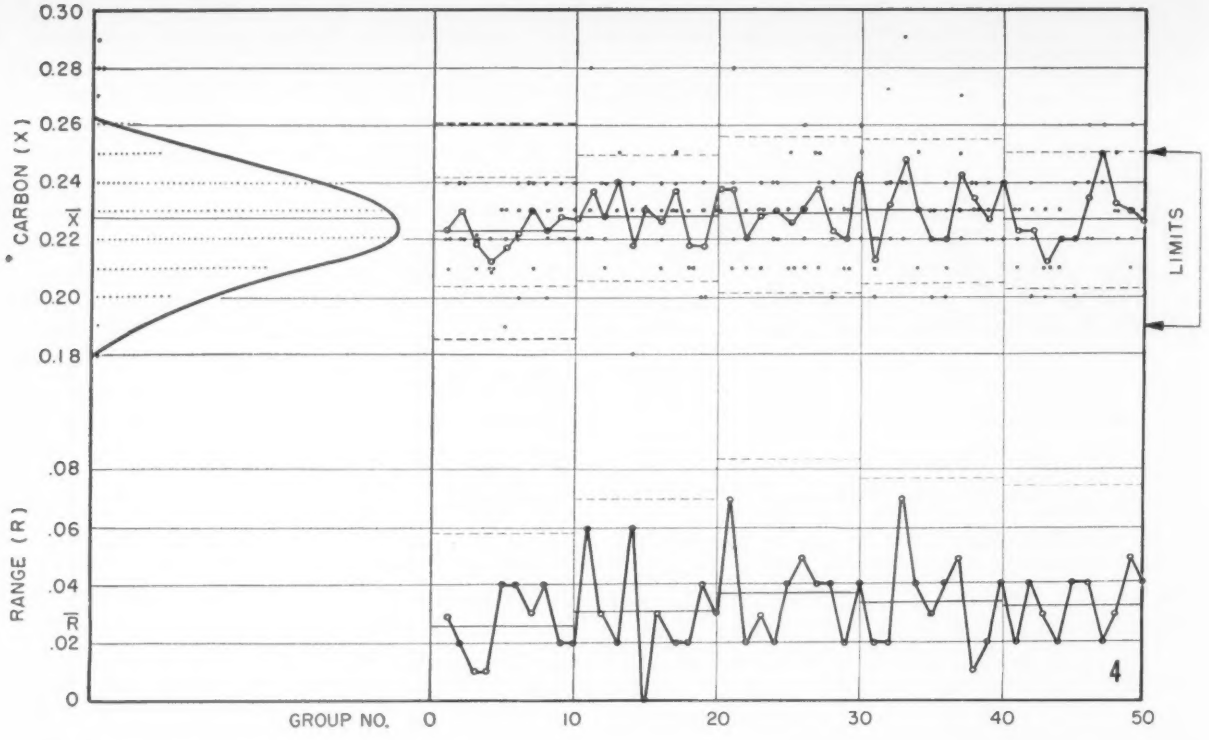


Fig. 4—Control chart indicating limits of variation in measurements that can be expected to result from chance causes in operating process

the average line (designated as $\bar{x}$) and the statistician uses sigma to name or define the individual width of any one of these strips. As shown in Fig. 3, 99.7 per cent of the values of a normal distribution will lie within these six strips (or within three sigma limits).

In the shop application of quality control, however, another method is used in place of the frequency distribution just described, which gives a system that is simpler yet, for its purpose, even more effective. This scheme is known as the "control chart," the "average and range" chart, or as the "$\bar{x}$, $\bar{R}$" chart such as shown in Fig. 4. While all the measurements actually needed for judgment, comparison and action may appear on the data sheets, such information is nowhere near as usable as when it is put into this graphic form. The chart is the newsreel of the system. It is based on the same principles as the frequency distribution chart in that the control limits are calculated on the same basis as the "three sigma" limits of that chart and therefore indicate the limits of variation in the measurements that can be expected due to chance causes in the process. Such charts, then, reveal not only the level at which the process operates and any trend in that level (desirable or undesirable) but also whether any single result or short term group of results represent real trends or only accidental variations occurring by chance.

After the initial construction of such charts, it is not necessary to wait until a great mass of measurements has been collected to plot them; in fact, it is desirable not to wait since, to be of the most value, the charts should be plotted as soon as feasible after the measurements are made. In general, 40 observations or measurements are sufficient to start such a chart but more readings would give a better background.

These observations can be collected in groups of three, or four, or five, or even ten successive measurements for plotting, because it is generally accepted that it is more satisfactory to look for causes of variability in groups rather than in single determinations. At National Malleable, a grouping of four successive measurements is used because this was the grouping that was thought to be most satisfactory by the Ordnance Department when the control scheme was suggested. Groupings of five measurements are also very commonly used.

Some of the considerations behind the group size are: (1) to avoid too frequent computation of group averages and ranges (such as would be the case if groups of two or three were used), yet (2) to plot the points frequently enough to quickly catch indications

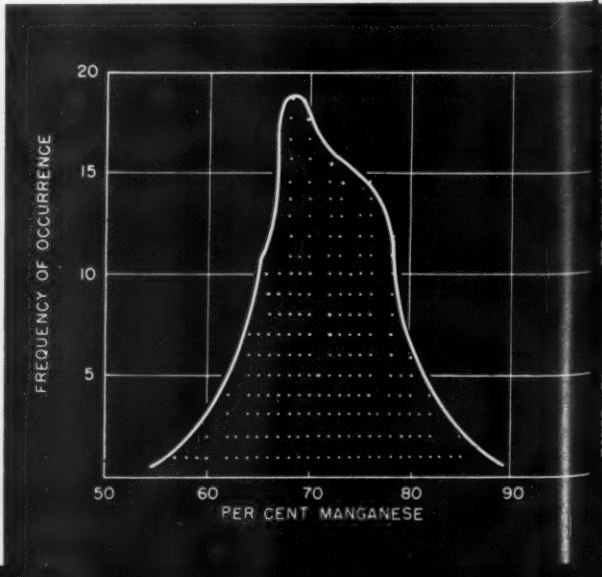


Fig. 5—Frequency distribution curve for manganese

of lack of control in a particular operation.

Attention is again directed to Fig. 4 and to the lot of 200 carbon determinations previously discussed. Values are divided into groups of four consecutive determinations, and each carbon value is plotted as a dot. The next step is to determine the average carbon value (x) for each group of four dots and these averages are also indicated on the chart (usually as circles). Then the grand average ($\bar{x}$) for each lot of ten groups (40 values) is determined and plotted as a horizontal line for the group. This is the center line or the average level of performance for these 40 values.

Thus there is obtained the following average values for each of the groups 1 to 10 inclusive: .224, .230, .218, .212, .218, .222, .230, .222, .228, .228. The grand average ($\bar{x}$) for these ten averages is .223. In a similar way, the grand average is determined for each of the other four lots of ten groups (11 to 20), (21 to 30), (31 to 40), (41 to 50).

Next, the range of each group of four carbon values is determined by subtracting the lowest value from the highest value in the group of four and this difference is plotted on the same vertical line as the group but to a scale that is set up at the bottom of the page (as shown in Fig. 4). What one measures by the range is the same thing that is measured by the shape or spread of the frequency distribution charts just discussed and which is measured by the standard deviation (σ).

Knowing the scatter or spread of results, the locating of the "control limits" or "action lines" completes the chart. This is accomplished by using numbers derived for this purpose by mathematical statisticians. These numbers depend on the size of the grouping used. Where the observations (carbon values, in this case, are plotted as groups of four successive determinations), this conversion value is .729; for groups of five observations, the value is .577. These numbers are referred to as A_2. As someone put it, they are based on mathematical derivations and to use them you do not need to know how to derive them, any more than you need to know how to build an automobile in order to use it.

Having found the range for each group of four observations, the average range ($\bar{R}$) for each group of ten ranges can be determined just as the grand average ($\bar{X}$) was determined for each group of ten average values. Thus for group 1 to 10, the individual range values (.03, .02, .01, .01, .04, .04, .03, .04, .02, .02) give an average value of .026, which is the average range ($\bar{R}$) for that group. So the average range is determined for each of the other groups (11 to 20, 21 to 30, 31 to 40, 40 to 50).

TABLE I - CARBON ANALYSES - GRADE B STEEL

0.24	0.22	0.22	0.21	0.22	0.24	0.24	0.22
0.22	0.24	0.22	0.21	0.21	0.22	0.21	0.21
0.23	0.23	0.19	0.22	0.22	0.23	0.20	0.24
0.23	0.24	0.21	0.24	0.23	0.22	0.20	0.23
0.22	0.22	0.24	0.22	0.22	0.24	0.23	0.28
0.22	0.22	0.23	0.21	0.24	0.24	0.22	0.24
0.25	0.24	0.23	0.18	0.23	0.24	0.22	0.23
0.23	0.23	0.23	0.21	0.23	0.24	0.22	0.23
0.23	0.24	0.25	0.22	0.23	0.21	0.21	0.20
0.23	0.24	0.20	0.23	0.26	0.22	0.23	0.23
0.24	0.21	0.28	0.22	0.23	0.22	0.21	0.24
0.22	0.23	0.23	0.21	0.22	0.22	0.24	0.24
0.25	0.21	0.21	0.23	0.22	0.26	0.23	0.21
0.25	0.24	0.21	0.25	0.20	0.22	0.23	0.24
0.23	0.21	0.21	0.23	0.22	0.25	0.26	0.24
0.22	0.21	0.22	0.20	0.24	0.23	0.24	0.22
0.24	0.22	0.29	0.24	0.23	0.21	0.23	0.25
0.22	0.20	0.23	0.23	0.24	0.20	0.23	0.21
0.23	0.22	0.25	0.27	0.24	0.23	0.23	0.24
0.22	0.22	0.24	0.23	0.24	0.26	0.24	0.22
0.23	0.22	0.21	0.23	0.23	0.20	0.24	0.22
0.21	0.20	0.21	0.23	0.22	0.22	0.23	0.21
0.22	0.24	0.22	0.20	0.24	0.26	0.22	0.22
0.24	0.26	0.25	0.25	0.23	0.23	0.22	0.25
0.26	0.23	0.22	0.21	0.24	0.20	0.23	0.23

Average 0.228 % Carbon

Now, the number A_2 (.729 for groups of four observations) is used as a multiplier with the average range ($\bar{R}$). Thus for group 1 to 10, we have $A_2\bar{R}$ = (.729) (.026) = .019, after rounding the product to three decimal places. This number is then added to and subtracted from the center line value, $\bar{X}$, to give the location of the control limits for the average values. Using U.C.L.$_{\bar{x}}$ for "upper control limit on averages" and L.C.L.$_{\bar{x}}$ for "lower control limit on averages," we have for group 1 to 10:

U.C.L.$_{\bar{x}}$ = $\bar{x}$ + $A_2\bar{R}$ = .223 + (.729) (.026) = .242

L.C.L.$_{\bar{x}}$ = $\bar{x}$ − $A_2\bar{R}$ = .223 − (.729) (.026) = .204

These values are drawn in on the upper graph of the chart, in Fig. 4. Similarly, control limits are calculated for each group of ten average values (11 to 20, 21 to 30, etc.).

In addition the control limits are calculated for the range or spread of values. Because it is impossible to have less than zero spread the lower control limit automatically becomes zero. The upper control limit (U.C.L.$_R$) is found by multiplying the average range for each group of ten range values by a factor depending on the number of observations in each group. This factor is 2.282 where four observations are grouped (as in this case), it is 2.114 if five observations are grouped. Thus to find the U.C.L.$_R$ for group 1 to 10, we have (.026) (2.282) = .059. Similar results will be found for each of the other groups (11 to 20, 21 to 30, etc.).

Now what do these charts tell us? Why go to all this trouble? A process is "in control" at the level at which one is operating when all the points on the chart lie between the control limits and not entirely on one side of the average line. May it be empha-

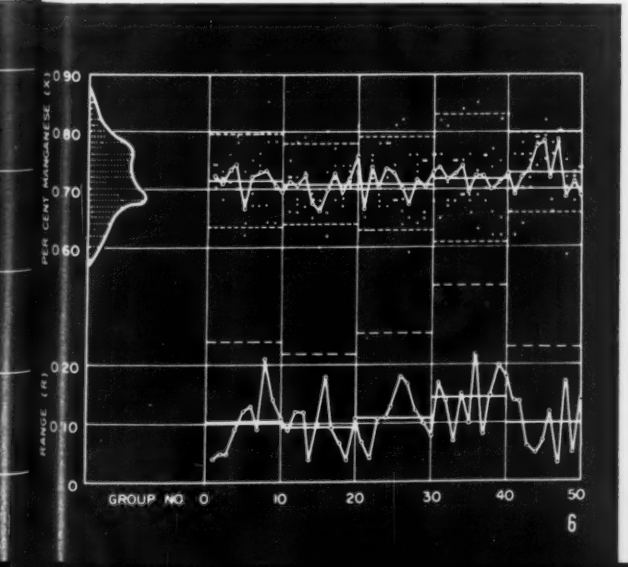


Fig. 6—Control chart for manganese content of heats

sized again that these limits for the carbon values are the limits for the *average* carbons for each grouping of four determinations. (If one wishes to include limits for individual points, a different A_2 factor must be used and will give limits such as have been drawn in for the first group (1 to 10). However, the major interest is in the average performance and, in the present case, it can be seen that all average values lie within control limits. The point for the 47th group is on the upper control limit but not outside.

In addition, all of the range values lie within their control limits. What the chart says is that if operations are continued as at present, one may expect to produce carbons that will fluctuate about a value of .228 and that the total fluctuation will not be greater than .08 carbon and will average about .035 carbon. If this is giving a satisfactory product it is only necessary to go ahead plotting results; if the results are unsatisfactory then some change must be made in the process that will change the level or the spread of results to conform to the desired needs.

Occasionally, an individual carbon may be considerably outside the desired limits, but the fact that the average values are still within their control limits assures that the process is still within satisfactory control and that the individual point represents only an accidental or chance occurrence.

Returning again to the frequency distribution chart which has been redrawn on the left-hand side of Fig. 4, it is evident that the control limits for *individuals* will fall close to the ends of the curve (or the 3σ) limits which have been discussed previously. It also becomes evident from the control chart how the average carbon level has shifted from time to time, as reflected in the "skewness" of the distribution chart and previously referred to. The control chart gives a much clearer picture of what the process is doing than any other type of chart because it shows not only the level at which the process operates but it also shows any change or trend in level and also whether any single result or short-term group of results represents real trends or only accidental variations occurring by chance. That is why this method of charting is much more meaningful than that of any of the previous techniques discussed. Also, after the control chart is once established it is made up as soon as a group of analyses are made, instead of waiting for many analyses.

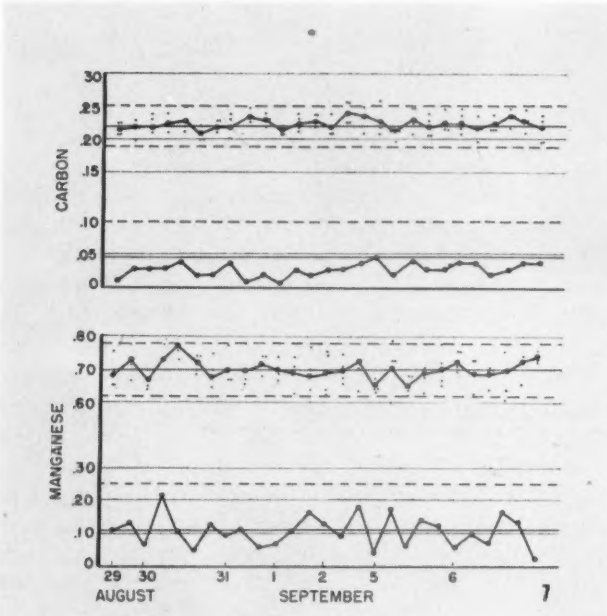


Fig. 7—Fixed control limits are set in this manner

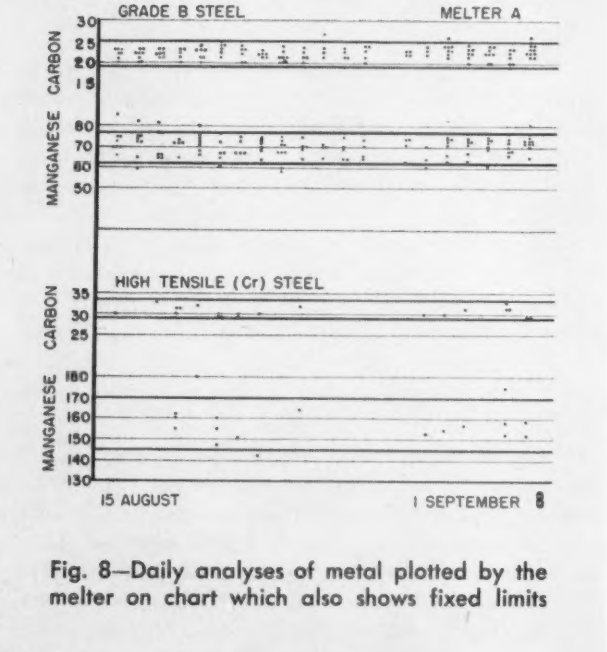


Fig. 8—Daily analyses of metal plotted by the melter on chart which also shows fixed limits

Manganese Values Are Plotted

Now let us turn to a similar discussion for manganese values comparable to carbon determinations.

Following the same order as for the carbon determinations the individual results are plotted and the average value calculated for the 200 determinations as 0.717 per cent manganese.

Plotting the data in the form of a frequency distribution curve gives a chart such as shown in Fig. 5. This is not a symmetrical or normal distribution, but one where the values cluster pretty well together and where the resulting curve is quite distorted. There is no peak at some value near the middle of the curve, such as was found for carbon distribution, which would indicate that not as desirable a value for manganese was obtained as for carbon.

If the data are plotted in the form of a control chart, using exactly the technique previously described and calculating average and range limits, we obtain the picture of the process that is shown in Fig. 6. It can be readily seen from this chart that, although there is a considerable spread of values, the average ($\bar{x}$) fluctuates about the level of 0.72 per cent manganese. Something happened at the time of the 44th to 47th groups to produce manganese values greater than for the rest of the 50 groups, but the level immediately returned to normal for the last three groups of the chart and no average values went

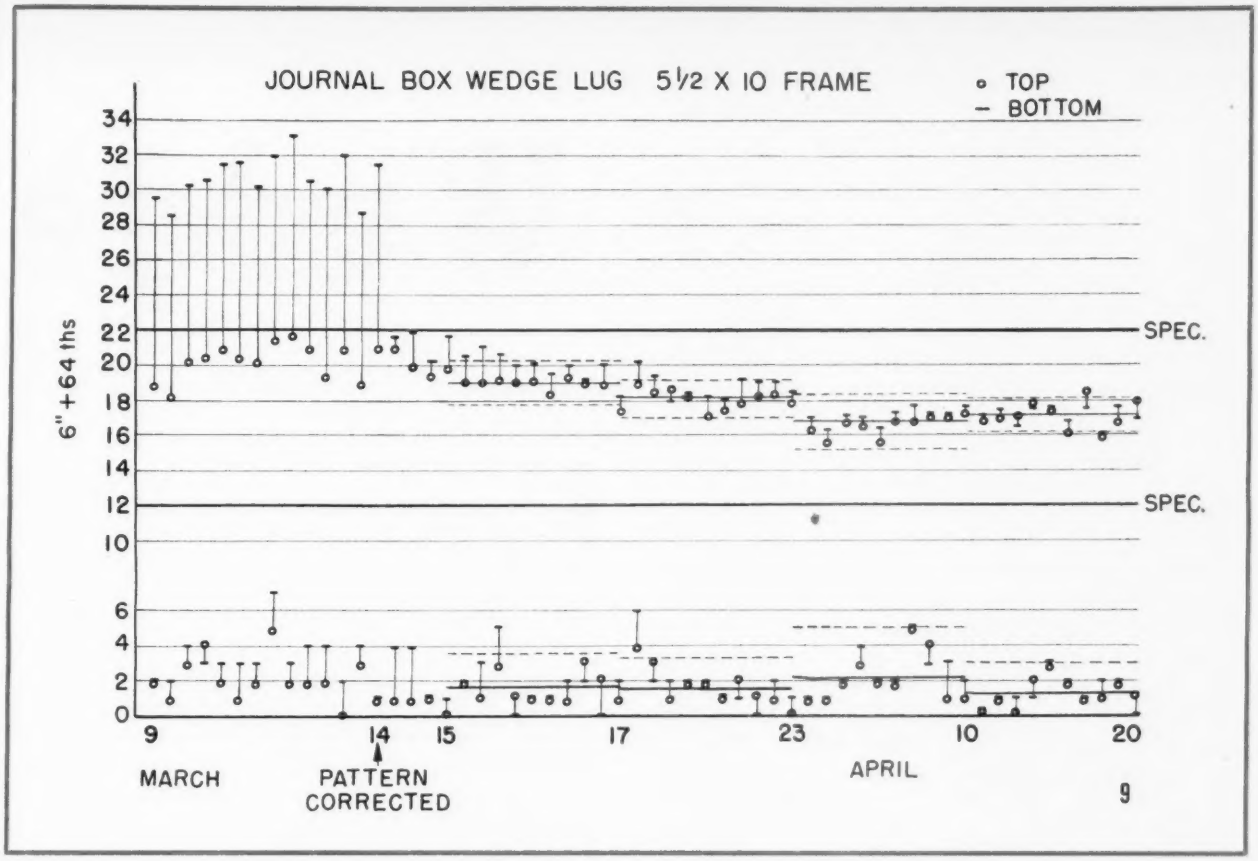


Fig. 9—Chart plotting dimensions of a casting

out of control limits. Therefore, no action needed to be taken.

The striking characteristic of the chart is the spread of results, or the range. This is especially so for the group numbered 31 to 40 where there is an average range of 0.145 per cent manganese and where could be expected a total range of 0.335 per cent manganese for the conditions under which the process is operating. If, in addition, unexpected conditions develop, a wider spread of results than this will be produced. Now, if this range is great enough to affect the uniformity of the heat treatment or the physical properties of the steel, then corrective steps should be taken to decrease the spread of manganese values.

Often the need for such correction can be seen from the direction in which the results are heading before they get out of hand (or out of control). For example, if the manganese had stayed at the unexpectedly high level of groups 44 to 47, or had even gone higher instead of dropping back at the 48th group, immediate action would have been called for.

Further steps frequently are taken with charts, such as have been discussed, where there is a continuing process which is operating satisfactorily. The first of these steps consists in establishing fixed limits (Fig. 7). The limits for such a chart are established on the basis of the satisfactory performance of the process over a period of time. For example, take the carbon and manganese charts just described. After possibly 100 groups (400 determinations) have been charted, a background is established for fixed limits. In other words, with a process operating at a satisfactory level and with a small enough spread of results to give the desired uniformity, the average values and the control limits can be extended as shown in the figure. The values are plotted as rapidly as they are determined and the control limits are not recalculated every ten groups.

As long as average and range points stay within control limits, or as long as only 1 in about 100 points falls outside of control limits, the process control is satisfactory. However, as soon as a trend is detected in either direction from the average, or the scatter of results becomes great enough to cause points to go out of control limits, action is called for.

Whenever any changes are made in the process, which will tend to change the location of these limits, then calculation of the limits is resumed for each ten groups of four determinations, until a sufficient background is established to fix new limits.

A second step is to break down the data so that it can be plotted by melters or even by first helpers. Purpose of this step is: (1) to create some competition among the operators to produce the desired results, or (2) to be better able to determine which operators are producing unsatisfactory results so that their technique can be changed.

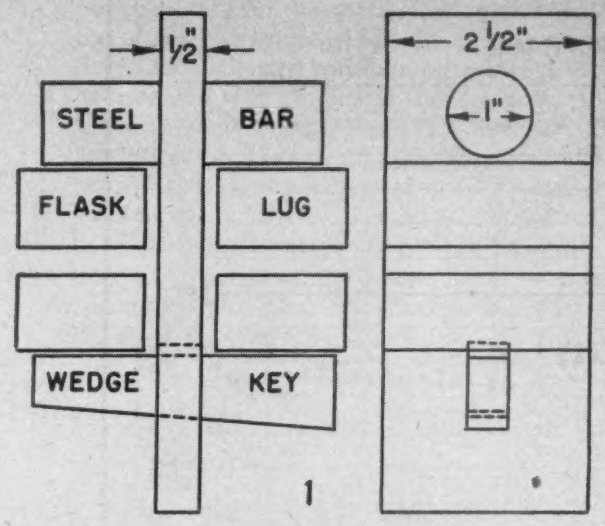
Such a chart is presented in Fig. 8. Here the fixed limits of the analyses of the control chart have been laid out and the daily analyses for which the melter is responsible have been plotted. To further emphasize lack of control, values falling outside control limits are circled with red so that they stand out. In the interests of simplicity, the data for each day are posted on one line and (*Please turn to page* 189)

Wedges

RECENTLY while commenting on a style of flask clamp shown in Fig. 1, a veteran molder claimed that, while the clamp had certain meritorious features, it by no means was a modern development. At one time or another he had seen several variations, all based on the same general principle, where a steel wedge was used instead of bolts, nuts or screws. In some instances the flask pins also served as clamps, with a wedge driven through a slot near the upper or lower end of the pin. In other instances the pins were fastened in place with wedges, but did not serve as clamps. One of these interesting little shop kinks was developed in the shop where he had served his time, and that was well over 30 years ago. Later in support of his contention he made several freehand sketches on the core oven door.

Developed for use in its own foundry the flask guide pin shown in Fig. 2 later was manufactured and placed on the market. It was originated by an experienced foundryman in the organization and was designed to reduce casting rejections caused by shifts, drops, crushes and run-outs at the parting line. These mishaps sometimes cut deeply in profit. Elimination meant stoppage of sizable leaks, and reduced cost of application and maintenance promised further gain.

The guide is simple in construction, consisting of four parts: A bracket *C* with the usual V-groove and which may be attached either to the cope or drag; a second bracket *B* with a rectangular slot; a guide of varying length designed to slide in the slot; and a flat key wedge, to serve as a cotter pin to hold the pin in place. No nuts, bolts or screws are involved. Neither wrench nor screw driver is needed to attach and adjust the device. This feature appeals to the



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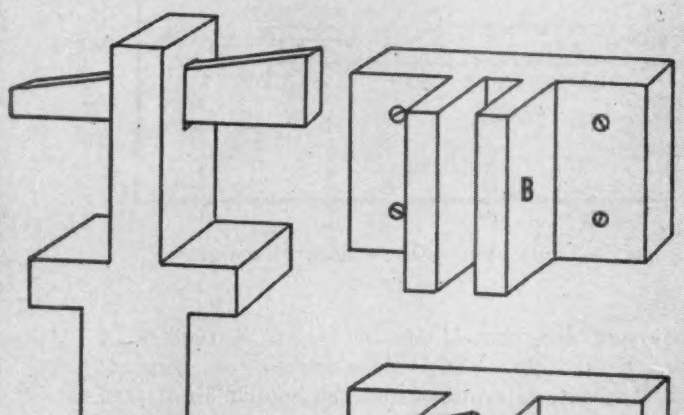

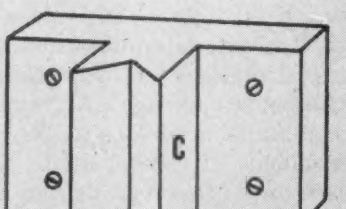

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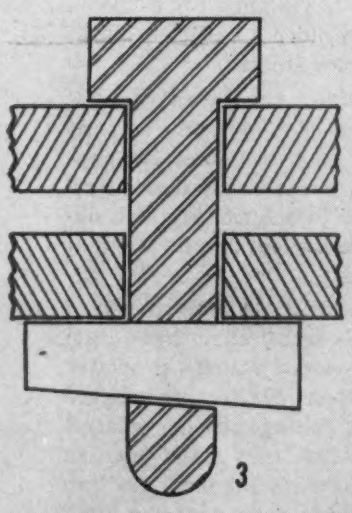
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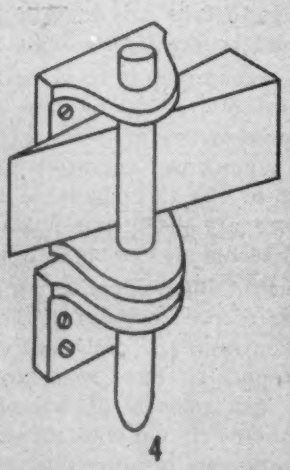
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Fig. 1—A piece of ½-in. flat steel, with a 1-in. diameter round bar welded in a hole near the top, is inserted in adjoining cope and drag lugs and fastened with a tapered key near the bottom

Fig. 2—In this combination the part *A* is fastened with a wedge in cope lug *B* so that it slides easily in the V-groove *C* attached to the drag

Fig. 3—A bolt is dropped through holes in adjoining flanges of the cope and drag after mold is closed. A flat tapered key is driven through a slot near the lower end of the bolt

Fig. 4—A loose pin may be tightened temporarily by driving a wood wedge between pin and flask wall

By PAT DWYER
Engineering Editor
FOUNDRY

Effective . . .

IN FASTENING PINS AND CLAMPS

molder who likes simplicity. The pin can be either attached or removed by tapping the key with a hammer or, for that matter, with anything that will serve as a hammer. A range of sizes provides a guide for every size and type of flask. Pins of various lengths are interchangeable and the angle-shaped bracket may be used in lifting the flask.

The device prevents the slightest shift and guides the cope absolutely straight either in lifting off or closing down. Rust or sand do not cause the guide to jam or prevent positive adjustment. Guide pins may be removed when the molds are closed and clamped. This affords an opportunity for mudding back of the guides, a precaution sometimes necessary to prevent a runout at these points.

Guides for large flasks used on the floor are furnished in four sizes with various pin lengths to accommodate flasks on different jobs. Pins may be removed without any difficulty. Out in the yard flasks may be stacked readily since no projecting pins are present. This feature also prevents the pins from being bent. Cost of replacement or repair practically does not exist with removable pins.

The illustrations show the simplicity of the device and the positive control it exerts in providing a straight lift and an accurate fit. On a snap flask the guides are adjusted before commencing the day's work. On individual flasks the guides are adjusted and applied to each one, thereby insuring a perfectly close fit. The guides may be applied to snap flask, to wood, cast iron, or other type of metal flask. They may be attached to matchplates used on molding machines and in all cases will insure accuracy and perfect match of cope and drag.

The clamp which brought on the discussion is shown in Fig. 1. A short piece of cold-rolled steel is inserted in a hole near the top of a flat, rectangular piece of steel of any convenient size, say ½ x 2½ x 6 in. The bar is welded permanently in place. Probably a one-piece casting would serve just as satisfactorily, but the job was done in a gray iron foundry where welding equipment was available and where the maintenance crew was accustomed to all kinds of miscellaneous repair work.

When the mold is closed the clamping device is placed in a gap in the lugs, or in the flask flanges with the round steel bar resting on top of the lugs or on the cope flange. The wedge key then is driven through the slot near the bottom of the device and tightened with a tap from the hammer. Key and slot are tapered and the upper edge of the key bears against the bottom face of the lugs, or flange on the flask. In the illustration a small amount of clearance is shown for clarity of presentation.

In a prominent machine tool foundry where large castings are molded in green sand encased in heavy cast iron flasks, the cope and drag are bound together in the manner shown in Fig. 3. A number of bolt holes are drilled in adjoining flanges of the copes and drags. The number depends on the size of the flask and the number of bolts required to hold them tightly together when the mold is filled with molten iron. Each bolt has a solid head, but is not threaded for a nut at the other end. Any practical foundryman who has had experience with threaded bolts in the foundry, knows that the life expectancy is extremely short. In life insurance language they are a poor risk. In foundry language synonyms for *poor* usually are employed. The bolt shown in the illustration may be applied easily and quickly. The only tool required is a hammer or a reasonable facsimile thereof. The wedge key is inserted in the slot, tapped once or twice with a hammer and the job is done. Before the mold is shaken out the key is released by tapping it in the opposite direction. The bolts are lifted out of the holes in the flanges. Keys and bolts are collected in any convenient receptacle to be placed in storage until needed again.

The device shown in Fig. 4 is not in the clamp classification, but is included because it shows a method for attaching a new pin or for tightening a loose pin with no other tools than a wedge and hammer. The pin should not be removed until after the flask had been clamped properly. This precaution will prevent a shift betwen cope and drag. One of the advantages of the device is that it may be adjusted to any desired length. For a deep lift or a high core in the cope, this advantage readily is apparent.

The principal advantage, of course, is the ease of application. All that is necessary is a common wood wedge easily driven between the pin and the bracket. It is removed just as readily by a light tap on the thin end of the wedge. Pin holes in the bracket are cored to 9/16-in. and then reamed or drilled to ⅝-in. diameter for small flasks. Other sizes will apply to larger pins and larger flasks. The face of the bracket between the lugs should be clean and flat to provide a good bearing for the wedge.

QUESTIONS and

Time for Starting the Blower

Q.—After charging the cupola we have been accustomed to closing the tuyeres and allowing the fire to burn for about an hour before starting the blower. Is that necessary? Do we get better iron than if we were to put the wind on immediately after the cupola is charged?

A.—Majority opinion favors the practice of letting the charge soak for about an hour before the blast is turned on. The practice is commendable and has several favorable features but it is not absolutely necessary. If the cupola is charged properly—that is, if the coke bed is the proper height, fuel and and metal ratio as it should be and the blower delivers air in correct volume and pressure—the iron will be just as satisfactory if the blower is started immediately after the cupola is charged, as it would be after holding the charged cupola for an hour or more.

The principal advantage gained by holding the cupola after it is charged lies in the fact that the first iron will come down a few minutes quicker after the blower is started. This is because a certain amount of preheating of the charges has taken place. After the blast is turned on it does not take so long to raise the temperature to the melting point. Instances are not unknown where the blast has been started after the first charge was placed in the cupola and with the remainder of the charge added as rapidly as possible.

Wants To Make Aluminum Bronze

Q.—We are planning to make aluminum bronze castings, a new field for us, and we would like to have information on handling, melting and pouring temperatures. We use gas-fired, crucible, pit furnaces.

A.—Aluminum bronze, like all copper-base alloys, should be melted under slightly oxidizing conditions and as rapidly as possible to hold to a minimum the absorption of deleterious gases. Opinions vary as to the need of a cover during melting; some use one and others do not. Several proprietary materials are available which are claimed to give satisfactory results. Pouring temperatures vary from 2030° F for heavy castings to 2230° for light castings; as is true with most castings, the best temperature is the lowest which will fill the cavity sharply and produce a sound casting.

Aluminum bronze should not be stirred any more than necessary as that practice tends to carry the aluminum oxide skin down into the alloy and result in inclusions in the castings. Excess stirring also increases the oxidation of aluminum from the alloy, causing higher metal loss.

Lip of the crucible in pouring should be as close to the sprue opening as possible, and the pouring action should be steady so as not to disturb the aluminum oxide envelope surrounding the metal stream. If that occurs there is a tendency for the pieces of disturbed skin to be carried into the mold cavity, resulting in inclusions.

Similarly, the mold cavity and gating system should be arranged so that the molten alloy flows without turbulence and agitation caused by abrupt turns, projecting cores, etc., which tend to disrupt the oxide skin. Aluminum bronze has a short freezing range, and liberal risers, as well as chills in sections hard to feed, should be employed.

Recovering Metal from Turnings

Q.—We have an accumulation of machine shavings in working cast aluminum that is far more than we can possibly work back into the crucible. Of course, we must recover as much metal from them as possible. All our efforts such as placing them on a heavy plate above the furnace, placing them in coke burners above the coke, etc., have failed. Can you give us information on a practical method for recovery?

A.—Highest recovery of metallic values from aluminum alloy turnings and chips is accomlished in large hearth type furnaces where the material can be covered completely by heavier scrap or where a special chamber, with its bottom submerged below the metal bath line, is built into the furnace. In both methods the fine material is protected from the oxidizing action of the furnace gases, and suitable fluxes can be used which aid in better recovery.

Recovery by crucible methods which is probably where your interest lies, is rather slow and tedious, and often the metallic winning is not too high. Procedure is to form a good-size heel of molten metal in the bottom of the crucible by melting some heavy scrap. Get it as hot as possible, and then add a small amount of the borings or chips, pushing them under the surface until dissolved. Do not add too much of the fine material—just enough that the bath still remains liquid. Then permit the metal again to become hot and fluid, and repeat the cycle until the crucible is filled. Pour off into pigs or ingots which may be anlyzed for composition.

A variation of that practice which might be tried is to take a length of steel pipe or tubing about 4 in. in diam, and attach it to a tripod or framework which can be set over the crucible in the furnace. To one end of the pipe affix a funnel large enough to shovel in the borings. Length of the pipe or tube is such that the lower end will be just beneath the surface of the first formed molten heel of metal, and the funnel portion a suitable height above the floor—assuming

Answers

of course, that you have a pit type furnace. Make a plunger or piston which will slide freely inside the pipe or tube. Coat lower end of tube inside and out with thin refractory, and dry well.

Procedure is to form a good size heel in the bottom of the crucible, and get it good and hot. Insert the pipe into the crucible, and charge some borings or chips, pushing them down under the surface with the plunger. With a good hot furnace and crucible, and selection of the quantity of borings added each time, it is possible to keep up almost steady charging until the crucible is full of molten metal. Using a furnace cover with a hole just large enough to admit the pipe or tube will eliminate most of the heat encountered in working over an open furnace.

Incidentally, your attention is directed to regulations issued by the National Production Authority applying to distribution and use of aluminum scrap. These are covered by NPA Order M-22.

Melting Temperature Too High

Q.—We have a 3-phase arc electric furnace of 1½-ton capacity in which we melt iron and steel. Scrap we use for the iron seems mostly of good grade, and we also use pig iron in varied amounts. We always have had trouble with the iron before we ever started melting steel. Analysis of the iron appears all right. We have poured consecutive heats of iron, hot and cold in the furnace, thinking that hot iron might have lowered the carbon. Hard castings are machined easily but always have been of close grain texture which we cannot avoid. As each heat was poured, the metal in the ladles contained much gas which formed bubbles, and as the bubbles broke, a blue flame appeared. That also occurs in the furnace. Remedies we have tried to stop the gas and shrinkage of the iron included use of 1 per cent soda ash to reduce sulphur and stop shrinkage; ground coke and ferrosilicon to build up graphitic carbon; manganese in the ladle to reduce gas, and aluminum in a similar manner. Can you tell us how to increase silicon and carbon and decrease the sulphur in the furnace? We also would like to know the amount of risers to feed a casting 8 x 17 in. and 2½ in. thick. We tried using two side risers 3 in. in diam with 9 in. head; gating into each. Casting showed two shallow spots ahead of the riser. Mold was not rammed too hard.

A.—From your description of the numerous gas bubbles which break and burn with a blue flame, we believe that your trouble is from operating at too high a temperature. The iron is so hot that it is undergoing what in steel melting practice is termed a "carbon boil." Therefore, we suggest that you reduce your power input as soon as the charge is melted so that the temperature of the iron will not exceed 2850° F. Perhaps to maintain that limit it may be advisable to cut the power off entirely once it is reached.

Your complaint about producing an iron with a close-grain texture is rather odd to us in view of the fact that you admit it is easy to machine. We would not worry much about the texture of the iron as long as it meets machinability requirements, and those of strength and wear resistance for example. It is possible that your objection is in relation to the latter properties, in that the strength is not as good as it might be, or the wear properties are poor. If that is the case, it might be that the graphite is precipitating in dendritic form rather than in flake form. Simple remedy for that condition is to add a graphitizing inoculating agent in the ladle such as one of the several proprietary materials available on the market or ferrosilicon.

Silicon in the iron can be increased easily by adding ground ferrosilicon in the ladle, and in the amounts required we believe that method preferable to trying to add it in the furnace where high losses might occur. Since graphite in iron precipitates during the solidification and cooling periods, the only way the amount can be changed is by changing the cooling rate. Slow cooling favors graphite precipitation while rapid cooling favors retention of carbon in the combined form. If you mean increasing the total carbon content of the iron, that can be accomplished to some degree by placing coke, or graphite in the form of lumps, blocks or electrode stubs under the furnace charge beneath the electrodes, and then rabbling them in the bath after it is molten and at temperature.

GANGWAY!

By J. A. PATTERSON

"Look, Mister, these Hollywood references aren't any good for th' casting job we have open here!!"

QUESTIONS *and Answers*

Best method for removing sulphur in the furnace is to use a basic lining and high lime slag. With an acid lined furnace, little if any reduction of sulphur could be obtained by adding soda ash since it would tend to react first with the silica in the lining. Besides it would be hard on the lining. Sulphur could be reduced by using soda ash in the ladle, but the ladle should be of at least 1000-lb capacity. While it would mean a double handling of the iron, it might be advisable in your case to pour all the iron from the electric furnace into a ladle large enough to hold the complete molten charge, treat the metal with soda ash, and then return it to the furnace where any loss in temperature could be restored, and maintained. In both transfers the slags should be completely removed before transfer—that is, the slag formed in the furnace during melting, and the slag formed on the ladle from the soda ash. Place about half the soda ash in the bottom of the ladle, and pour the iron over it, and when the ladle is about half full dump in the remainder of the soda ash. Amount may range from 5 to 10 lb per ton depending upon the desired sulphur removal.

With reference to your question on risers for the 2½ x 8 x 17-in. casting, we believe that it can be made with only one riser if that is placed as close to the casting as possible to provide a short neck. That will create a hot spot in the sand, and permit the neck to remain open to carry hot metal from the riser into the casting as solidification proceeds. Another method would be to pour the casting on end using pencil gates from a runner box to feed the metal. Gates should be as short as possible.

Sand May Be Rammed Too Hard

Q.—We are enclosing a piece of a flanged casting which shows a defective area where the flange and body meet. Bad spots do not occur regularly, and do not show up until casting is machined. Composition of the iron is 2.00 per cent Si, 0.084 per cent S, 0.17 per cent P, 0.65 per cent Mn, and 3.46 per cent TC. We believe that the trouble comes from the sand being on the wet side. Albany No. 1 sand is used, and castings are made on the bench.

A.—The defective area on the casting submitted for examination is a blow resulting from gases or steam at the mold interface which prevent the metal from lying quietly. As you point out, the trouble might arise from the sand being on the wet side, but it also might be due to hard ramming. Possibly from time to time the molder has trouble with the sand breaking off at the sharp re-entrant angle formed by the flange and body, and gives the sand a few extra licks with the pein end of the rammer at that point to make it firmer. Perhaps at times the molder gets only a thin layer of sand on the pattern in spots, and when rammed it will be compacted much harder than the remainder.

Re-entrant angles on a casting always are a possible source of trouble since the gases developed on contact of molten metal and sand are in a confined area, and unless they can escape easily they strike back into the metal. Hence if the permeability of the sand is low in that area due to the characteristics of the sand itself, or produced by hard ramming, or if large quantities of gas are developed due to excess moisture or high amount of carbonaceous material, blows are likely to occur.

If those factors are such that no great back pressure is developed, the disturbance is not so great, and sometimes it is difficult to locate the opening or openings through which the gas penetrated the skin of the casting. That is what we believe occurred in your case since you mention it did not show up until the castings were machined. Under conditions where the back pressure is great, the blows are plainly visible on the casting surface.

While it is not difficult to point out possible causes of the trouble, determining the exact culprit is another matter. If you believe it is the result of excess moisture, check that point for a period to find out the best range, and see that the sand is maintained within it. However, we suspect that hard ramming may be the cause. Watch the molding and see whether difficulty is encountered with the sharp edges of the mold breaking or crumbling when the pattern is removed. If that occurs the sand may be on the dry side, or it may lack sufficient bond. Also there is a possibility the sand is not being mixed properly, and it is not uniform in moisture and bond.

Wheat Flour as a Core Binder

Q.—The nearest foundry supply house with stocks of modern and proprietary core sand binders is nearly 400 miles away. Wheat flour around here is cheap and plentiful on account of damaged sacks, and some slight rodent and insect infiltration. Our present core sand mixture contains 3 parts fairly coarse molding sand, 6 parts river bed sharp sand and 1 part flour. Baked cores are quite hard and are on the blowing border line. While running off a heat the acrid smoke from the vents is highly offensive. We shall appreciate your comment on the situation.

A.—While your present core sand mixture is fairly satisfactory, it could be improved by reducing the flour content. The amount of reduction will depend on the amount of molding sand in the mixture. As the molding sand content goes up, the flour content goes down. With your present mixture 1 part flour to 10 or even 12 parts sand will make satisfactory cores, and incidentally reduce the amount of irritating smoke when the cores are surrounded or almost surrounded with molten iron.

Molding sand is added to sharp sand to increase the green strength and thus prevent the cores from sagging, to produce a smoother face on the casting, and make the mixture easier to ram in the corebox. In exceptional instances the molding sand content may

(*Concluded on page* 104)

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Fast, efficient sand conditioning, in tonnages to meet your needs, is assured when you use a Royer Sand Separator and Blender. Over 8000 of these cost-cutting machines are installed in foundries all over the world . . . producing properly prepared molding sand for jobbing and production shops. More than 50% of the Royer users have ordered additional machines—concrete evidence of their efficient performance.

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Model	Tons Capacity per hour	Electric Motor	Net Weight Lbs.
Junior	4 to 7	½ HP	270
NB-2	7 to 9½	¾ HP	465
NB-4	7 to 9½	¾ HP	510
NC-2	12 to 15	1½ HP	660
NC-4	12 to 15	1½ HP	730
NDP	20 to 25	2 HP	1265
NDS	20 to 25	2 HP	1070
NRS	40 to 50	5 HP	1375
D Special	20 to 25	.....	700
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QUESTIONS *and Answers*

(*Concluded from page* 102)

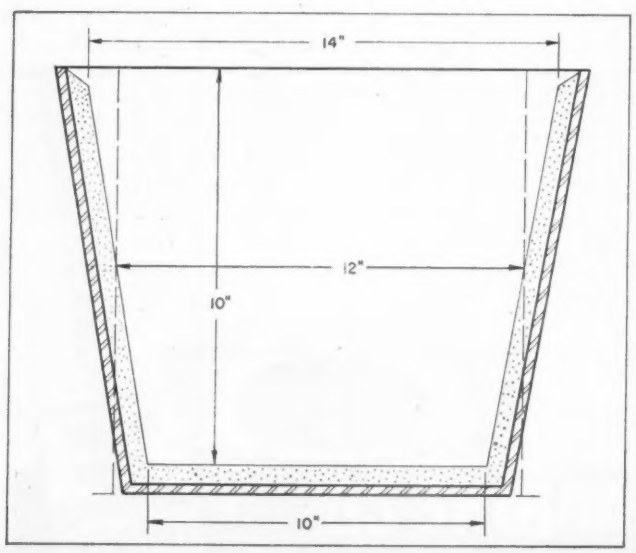
be increased to 50 per cent. Objection to the use of molding sand is that it reduces the permeability of the core. In many large cores exposed to the metal only in limited area, great permeability is not an important factor. In small intricate cores, or any cores almost surrounded with metal, high permeability is extremely important. All of which means that relative amounts of bank sand and sharp sand are regulated in conformance with the required degree of permeability.

A point frequently overlooked is the necessity of providing an artificial passage or passages for ready escape of gases generated when the core is raised to a high heat. Scabs and buckles on the casting sometimes are blamed on a *tight* core sand mixture, when in reality the mixture is quite satisfactory, but the core is not vented properly and sufficiently. This observation, of course, also applies to the necessity of providing a clear passage from the vent opening in the core to the outside atmosphere.

To Estimate Capacity of Ladle

Q.—Recently we received a small book from a foundry supply house containing among other items of information a table for quickly figuring the capacity of iron foundry ladles. Unfortunately, my early education was neglected and while no doubt the information is all that it should be, we do not understand it well enough to apply it. We are enclosing the table and will appreciate your kindness in showing us how to read it.

A.—The table is based on the fact that a circular iron plate 1 in. thick weighs a definite amount. The table shows the weight of a circular plate 1 in. thick in diameters from 12 to 144 inches. The diameter in inches is given in one column, and the weight in pounds is shown in an adjoining column. For example a 12-in. diameter plate weighs 29½ lb. A 13-in. diameter plate weighs 35 lb and so on down the list. When you have found the weight of 1 in. of iron in the ladle you readily may find the total capacity by multiplying the figure representing the 1 in. by whatever figure represents the depth of the ladle in inches.



Rule is based on height and mean diameter of the ladle

Method of working the example is shown in the accompanying illustration. Diameter at the top of the ladle is 14 in. Diameter at the bottom of the ladle is 10 in. Obviously if the capacity of the ladle is figured from the top diameter it will be too great. If it is figured from the 10 in. diameter it will be too small. To find what is known as the mean or common diameter the figures representing the top and bottom diameters are added and the result is divided by 2. The formula in this instance is $14 + 10 \div 2 = 12$. Referring to the table you will note that a 12 in. diameter plate weighs 29½ lb. Therefore if the ladle is 10 in. deep, the total capacity will be $29\frac{1}{2} \times 10 = 295$ lb. The same rule, of course, applies to finding the weight of iron at any depth in the ladle. All dimensions are in inches.

Damp Lining Caused Hard Iron

Q.—In correspondence with various people, including suppliers of zircon as a molding sand and a refractory, certain questions have been unanswered. In one heat of 1000 lb, for example, in our 1000-lb, high-frequency induction furnace the iron was very close grained and unmachinable even though we added 5 lb of silicon carbide and 3 lb ferrosilicon to the basic mix. This was the first heat from a relining that consisted of 50 per cent zircon and 50 per cent mullite. We have a feeling that the zircon might have imparted a chilling tendency to the iron, thereby making it unmachinable, or else something else occurred that was not apparent or readily diagnosed. Even though zircon does have chilling tendencies, it is hard to believe that by mixing it thoroughly with mullite and ramming it up as a dense refractory in a furnace that it would cause trouble. Very little zircon is left on the gates and risers from the molds.

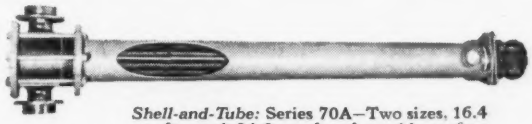
A.—So far as we can ascertain, it hardly is likely that the zircon in your furnace lining would be reduced to metallic zirconium and enter the iron. Even if it were, its avidity for oxygen and other gases, as well as sulphur, would soon cause its elimination. In fact, zirconium is used as a deoxidizer and degasifier in iron and steel. Therefore, it appears that your trouble with unmachinable iron was due to some other cause. You mention that this particular heat was the first one from the relined furnace, and we strongly suspect that the lining was not thoroughly dry.

When that condition exists the molten metal will pick up the hydrogen developed by dissociation of water vapor at high temperature, and hydrogen tends to act as a carbide stabilizer. There also is a possibility that through some error or carelessness sufficient chromium-bearing material may have been placed in the charge to produce hard iron.

"KARBATE" BRAND IMPERVIOUS GRAPHITE HEAT EXCHANGERS *FOR ALL PURPOSES!*

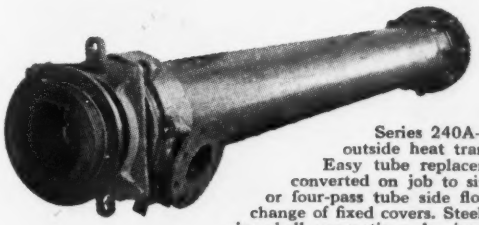
The "Karbate" impervious graphite heat exchangers illustrated are used extensively as boilers, coolers, condensers, vaporizers, evaporators, heaters and absorbers in handling corrosive chemicals, either hot or cold. They *all* can be had in a complete size range. *All of them* offer the following advantages:

- **Highest heat conductivity rate of the practical corrosion-resistant materials.**
- **Highly resistant to corrosion by acids or alkalis, hot or cold.**
- **Freedom from corrosion scale, as compared to metals.**
- **Immune to thermal shock.**
- **No contamination of product.**
- **Strong and easy to install and maintain.**



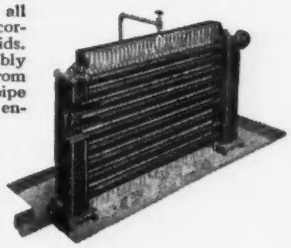
Shell-and-Tube: Series 70A—Two sizes, 16.4 sq. ft., and 24.6 sq. ft. of outside surface area respectively. Tubes easily replaced in the field. Interchangeable single and double-pass construction.

Style FH heat exchangers (Size 1½): Are especially recommended for tanks with solution depths of 16 inches or less. Write for catalog section S-6750.



Series 240A—70.6 feet of outside heat transfer surface. Easy tube replacement. Easily converted on job to single, double, or four-pass tube side flow by simple change of fixed covers. Steel, shell, oversize shell connections, impingement plates and drain and vent plugs integral with shell end castings. Stainless-steel baffles assembled with steel tie rods to form protective cage for tube bundle. Removable "Karbate" tube bundle. Write for catalog sections for S-6690, S-6715 for details of applications, maintenance, sizes and characteristics of these exchangers.

Cascade coolers: For all cooling jobs involving corrosive gases and liquids. Complete cooler assembly may be made quickly from 4 standard items in 5 pipe sizes. Capacity easily enlarged or reduced by adding or subtracting standard sections. Compact construction to save plant room. No special supporting structure needed. Write for catalog section S-6780.



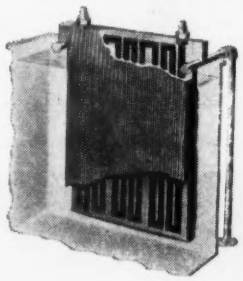
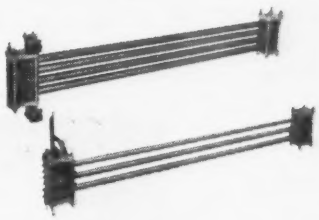


Plate heaters: Used to heat or cool corrosive liquids in tanks and vessels. Compact, completely assembled, easy to put in. Used in pickling, etching, plating and cleaning tanks. Complete size range. Models for horizontal and vertical mounting. Write for catalog section S-6620.



Concentric Tube exchangers: Available in two types. Series 10A is small, low-priced, gives true counterflow. Exceptionally good for small flow rates at narrow temperature differences . . . Series 20A manufactured with "Karbate" inner and outer piping, and is used to transfer heat between two corrosive fluids. Both have sectional construction, can be added to or subtracted from at will. Sturdy, can be moved from place to place after assembly, adapted to any method of mounting on floor, wall, or ceiling. Write for catalog section S-6670.

The term "Karbate" is a registered trade-mark of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco

In Canada: National Carbon Limited
Montreal, Toronto, Winnipeg

A full line of "Karbate" impervious graphite pipe and fittings

for conveying corrosive chemicals includes: "Karbate" pumps of advanced design embodying impervious graphite case, impeller, and a rotary seal which eliminates the stuffing box. Pump prices reduced up to 33%. Write for catalog section S-7000 for pipe information, S-7200 for pump information.

MEN
of Industry

WALTER C. BLADIN has been appointed assistant to the vice president, Burnside Steel Foundry Co., Chicago. Mr. Bladin attended Chicago Technical College and Armour Institute. Prior to joining Burnside Foundry 25 years ago he was associated with Pullman-Standard Car Mfg. Co., the Chicago plant of Pressed Steel Car Co., and chief engineer of the Chicago-Cleveland Car Roofing Co.

♦ ♦ ♦

Herbert J. Cooper has been appointed general manager, Cooper Alloy Foundry Co., Hillside, N. J., in charge of foundry, machine and pattern shop activities. Mr. Cooper, a graduate of Columbia University School of Metallurgy, has been assistant general manager engaged in research development of centrifugal casting and oxygen injection technique. **R. J. O'Connor,** formerly manager of standards, has been named foundry superintendent. **John J. Ford,** formerly time study engineer, succeeds Mr. O'Connor as manager of standards. Messrs. O'Connor and Ford came to the company 6 years ago from American Brake Shoe Co.

♦ ♦ ♦

Lawrence A. Hagney has been named president, Galva Foundry Co., Galva, Ill., succeeding **Fred C. Heiden** who continues as a director. Other officers recently appointed include **Oakley Marlatt,** vice president-comptroller, **Harry C. Heyl,** secretary, and **Ray F. Heiden,** treasurer.

♦ ♦ ♦

Karl E. Baker, until recently foundry foreman, National Radiator Co., New Castle, Pa., is assistant manager, Campbell, Wyant & Cannon Foundry Co., Muskegon, Mich. Mr. Baker entered the foundry industry in the core department, Pittsburgh Steel Foundry, Glassport, Pa., and later spent 22 years at Chicago Pneumatic Tool Co., Franklin, Pa., where he became foundry foreman and assistant superintendent.

♦ ♦ ♦

E. C. Girty, since 1949 general superintendent, National Roll & Foundry Co., Avonmore, Pa., has been made vice president in charge of operations. Previously he was research metallurgist, production development engineer and superintendent, Pittsburgh Rolls Division, Blaw-Knox Co., Pittsburgh. **W. E. Curran,** who joined the company in 1942, has been named to succeed Mr. Girty, and **J. C. Kepfer,** executive assistant. **Reynold E. Klages** has been named chairman of the board and **Leland E. Smith,** vice president.

♦ ♦ ♦

Morse G. Dial, since 1949 director, vice president and treasurer, Union Carbide & Carbon Corp., New York, has been elected executive vice president. A graduate of Cornell University, Mr. Dial joined Union Carbide in 1929 as a member of the sales staff of Carbide & Carbon Chemicals Corp. He was successively sales manager and general manager of the Pyrofax Division of that company. **Dr. George O. Curme Jr.,** since 1948 vice president in charge of chemical research for the corporation, and for many years a vice president of Bakelite Co. and Carbide & Carbon Chemicals Co., divisions of the parent company, has been elected vice president in charge of all research activities of Union Carbide.

♦ ♦ ♦

Richard J. Ruff has been elected president of the Catalytic Combustion Corp., Detroit, following retirement as president, Michigan Oven Co., there, which he organized in 1949.

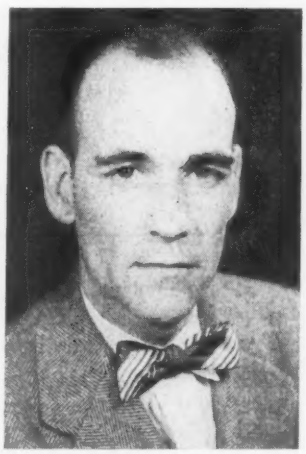
♦ ♦ ♦

Charles H. Parcells has been awarded the first International Nickel Co. graduate followship in metallurgical engineering at Illinois Institute of Technology, which provides for two years' study leading to a doctor's degree and carries an annual award of $1500 and tuition. Mr. Par-

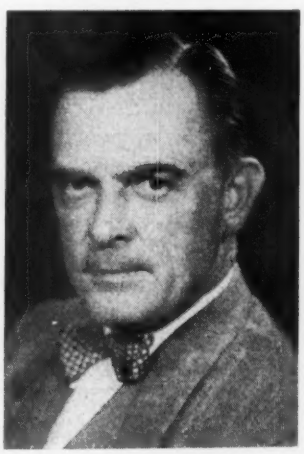
(*Continued on page* 108)

WALTER C. BLADIN
. . . Burnside Foundry executive

HERBERT J. COOPER
. . . Cooper Alloy Foundry mgr.



R. J. O'CONNOR
. . . fdy. supt., Cooper Alloy



JOHN J. FORD
. . . Cooper Alloy standards mgr.

PYNE ORE MINE

Principal Source of Iron Ore from which Uniform Quality Woodward Iron is Made

Pyne Ore Mine, located only five miles from the blast furnaces, is one of the largest underground ore mines in the United States and the principal source of ore used in making Woodward iron. Uniform quality of ore used in the production of Woodward iron is one of the important factors in maintenance of that consistent uniformity for which Woodward iron is known in the foundry trade.

Pyne Ore Mine is one of three Woodward owned and operated red ore mines which, with reserves estimated to be adequate for the remainder of the century, contribute importantly to making Woodward a dependable source of uniform quality merchant iron.

WOODWARD IRON COMPANY

WOODWARD, ALABAMA

Independent Since 1882

GENERAL SALES OFFICE: 1515 First National Building • Birmingham, Alabama • Phone 54-1667

(*Continued from page* 106)

cells received his bachelor's degree in metallurgical engineering from Rensselaer Polytechnic Institute and master of science degree from Illinois Institute of Technology, where he has been an instructor in metallurgy for the past year.

♦ ♦ ♦

Richard R. Deas, until recently research director, Hamilton Research & Engineering Corp., Anniston, Ala., has been named assistant to the vice president in charge of production, Hamilton Foundry & Machine Co., Hamilton, O. Mr. Deas attended University of Alabama and entered the foundry industry at American Cast Iron Pipe Co., Birmingham, where he was in charge of research and development of new products and later works manager. More recently he was associated with Lester B. Knight & Associates, Chicago, as senior foundry engineer, prior to his association with the Hamilton research company. He has been serving as a director of Birmingham District Chapter of the AFS.

♦ ♦ ♦

Ralph O. Anderson, since 1949 district manager of the St. Louis office, Norton Co., Worcester, Mass., has been appointed abrasive consultant, Machinery Division, NPA, Washington. Mr. Anderson joined the company in 1912 and was formerly Denver district manager. **Gwynn L. Parrott,** who joined the Abrasive Division in 1944, and has been abrasive engineer in Illinois, will replace Mr. Anderson in St. Louis.

♦ ♦ ♦

J. Douglas James, who has been elected chairman of the Northwestern Pennsylvania Chapter of the AFS, has been foundry superintendent, Cooper-Bessemer Corp., Grove City, Pa., since 1946. Mr. James was graduated from Grove City College in 1940, when he joined Latrobe Electric Steel Co., Latrobe, Pa. From 1941 to 1946 he was with Erie City Iron Works, Erie, Pa. A charter member of Northwestern Pennsylvania Chapter, he has served as treasurer and director and was vice chairman last year. He is also a member of the Pittsburgh Foundrymen's Association.

♦ ♦ ♦

B. Emmet Hartnett, metallurgical engineer, Chicago, has been appointed deputy director for the Chicago area of the Office of Price Stabilization. Mr. Hartnett was graduated from Loyola University and Illinois Institute of Technology and was president of the former Hartnett Foundry Co., Chicago.

♦ ♦ ♦

John Wiehe and **Walter Wenzel** have been named heads of a new plant engineering and planning department at the Norwood, O., Works, Allis-Chalmers, Milwaukee. **J. J. De Windt,** general superintendent, will supervise the new department, handling a modernization program which includes erection of nonferrous foundry and oil storage buildings, scheduled for completion this year.

♦ ♦ ♦

Benjamin A. Smith, vice president-secretary, C. O. Bartlett & Snow Co., Cleveland, has been elected president of the Cleveland Engineering Society. Other officers include: first vice president, **Harry Gellin,** the Gellin Co., second vice president, **Chester W. Rupert,** Standard Oil Co. of Ohio; treasurer, **Max B. Robinson,** Fenn College; and executive secretary, **Mary C. Manwell.**

♦ ♦ ♦

Eugene M. Stein, for the past 8 years research metallurgist, Gunite Foundries Corp., Rockford, Ill., has joined the metallurgical research staff, Battelle Memorial Institute, Columbus, O. Following graduation from University of Minnesota in 1936, Mr. Stein was metallurgist in the testing and research laboratories, Deere & Co., Moline, Ill.

♦ ♦ ♦

Dr. John C. Hostetter, retired, recently was the recipient of the fourth annual Albert Victor Bleininger Award, for distinguished achievement in the field of ceramics, awarded by the Pittsburgh section of the American Ceramic Society.

♦ ♦ ♦

Stuart H. Levison has been elected vice president in charge of zinc and coal operations, American Smelting & Refining Co., New York. Mr. Levison joined the company in 1912, became general manager of the company's zinc and coal operation in 1930 and was transferred to New York in 1932.

♦ ♦ ♦

Edwin A. Franke has been appointed chief inspector of the Metal Products Division, Koppers Co., Baltimore, and head of the new quality control department. Other organization changes include: **Edgar T. Stump,** assistant superintendent in charge of the Bartlett Hayward foundry and pattern shop; **Claude M. Skinner,** superintendent and **Ernest Russell,** production engineer of the new production engineering department; and **Philip Newhard,** superintendent of foundries, Piston Ring plant.

♦ ♦ ♦

Kenneth Jensen has been elected president, Kensington Steel Co., Chicago, subsidiary of Poor & Co., there, railway equipment supplier, succeeding **Eugene C. Bauer** who has become chairman of the board. **Eugene C. Bauer Jr.** has been named first vice president, **Edmund C. Anderson,** vice president, **Roy W. Ser-**

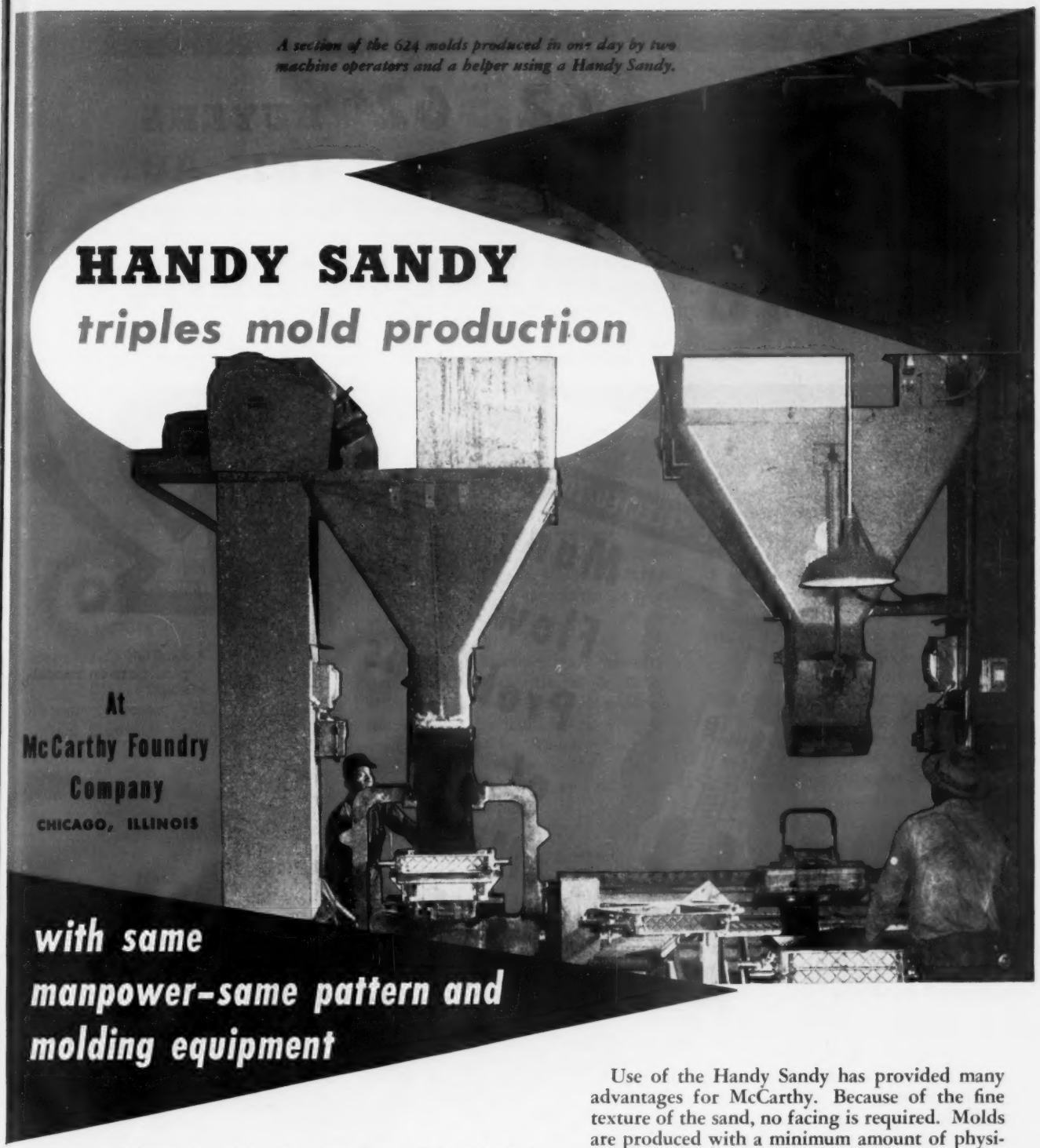
(*Continued on page* 111)

RICHARD R. DEAS
. . . Hamilton Foundry executive

RALPH O. ANDERSON
. . . abrasive consultant, NPA

GWYNN L. PARROTT
. . . Norton sales, St. Louis

J. DOUGLAS JAMES
. . . heads N.W. Pa. Chapter, AFS



Simply by taking the shovel out of the Molder's hand and replacing it with a Handy Sandy, McCarthy Foundry tripled their mold production. They still use the same pattern and molding equipment. Yet two machine operators and a helper have produced 624 molds in a single day using the Handy Sandy . . . compared to a maximum of 200 molds when filling the flasks by shoveling. This production is obtained on molds using a 20″ x 20″ pop-off flask. They have a mold height of 10″ with a 6″ cope and a 4″ drag.

Use of the Handy Sandy has provided many advantages for McCarthy. Because of the fine texture of the sand, no facing is required. Molds are produced with a minimum amount of physical effort. The increase in production has made possible faster deliveries — a factor that has won new business for McCarthy and has improved their service to present customers as well.

Yes, the Handy Sandy eliminates "shovel-fatigue" and lets the molder devote full time to producing molds. Your investment in equipment and labor brings you a greater return.

See how the Handy Sandy can multiply your mold production and save you costly expenditures for new patterns, manpower and molding equipment. Write today for complete details.

NEWAYGO | ENGINEERING COMPANY

NEWAYGO, MICHIGAN

Manufacturers of Neway Mold Handling, Sand Handling and Conditioning Equipment.

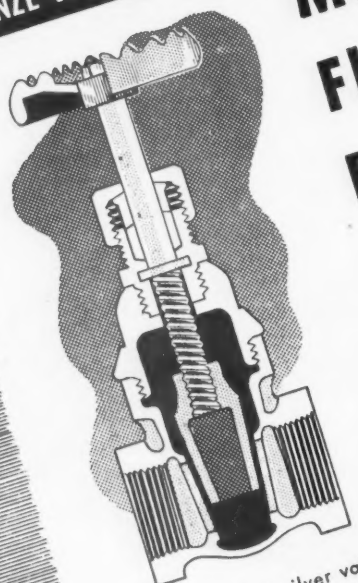
THIS MONTH, 62,562* BUYERS OF CASTINGS WILL READ THIS AD...

This is one of a series of 6 full page ads emphasizing the expanding industrial acceptance of Brass Castings. Nationally circulated in outstanding trade journals and read by manufacturers, engineers, contractors, metallurgists, production control men—*these messages reach the men who specify and influence the purchasing of castings!*

R. Lavin & Sons, Inc.

BRONZE VALVES ARE SELECTED TO CONTROL...

Many Flow Problems of Modern Industry



Bronze and nickel silver valves meet the requirements of many industrial flow control problems. First, because of the satisfactory engineering properties: pressure tightness, strength, ductility, and resistance to corrosion and erosion. Second, because of low foundry costs and excellent machinability. And third, because of their dependable service and long life.

Cast bronze meets the requirements of industry and consumer.

Specify—LAVIN NON-FERROUS INGOT—*Quality*

R. LAVIN & SONS, INC.
Refiners of Brass, Bronze and Aluminum
3426 SOUTH KEDZIE AVENUE • CHICAGO 23, ILLINOIS
REPRESENTATIVES IN PRINCIPAL CITIES

The Foundryman's Problems . . . Are Our Problems!

REPRINTS OF ENTIRE *Brass Castings* SERIES ARE YOURS FOR THE ASKING

* Audited Circulation plus pass-on readership.

ELMER C. ZIRZOW
. . . joins Werner G. Smith Inc.

GILBERT J. NOCK
. . . pres., N.E. Ohio AFS group

ANTHONY J. ZINO JR.
. . . heads Dixon Crucible sales

LLOYD CANFIELD
. . . foundry supplies, Kansas

(*Continued from page* 108)

geant, treasurer-assistant secretary, **Anthony J. Frystak,** secretary, and **H. M. Albers,** sales manager.

♦ ♦ ♦

Elmer C. Zirzow has been appointed director of foundry service, Werner G. Smith Inc., Cleveland. For the past three years Mr. Zirzow has been sand technologist in the testing and research laboratories, Deere & Co., Moline, Ill. Prior to that he was coreroom foreman, National Malleable & Steel Castings Co., Cleveland. Active in the American Foundrymen's Society, he has served on various committees of the Sand Division and was vice president of the Northeastern Ohio Chapter during 1947-48.

♦ ♦ ♦

Gilbert J. Nock, who has been named president of Northeastern Ohio Chapter of the AFS for 1951-52, has been vice president-secretary Nock Fire Brick Co., Cleveland for 4 years. Mr. Nock attended John Carroll University and Baldwin-Wallace College, and in 1926 joined the company which his father, Charles H. Nock, founded 14 years before. He became treasurer in 1944. Active in the Northeastern Ohio Chapter, he served as secretary from 1943-47, director from 1947-50, and vice president last year.

♦ ♦ ♦

Anthony J. Zino Jr., for the past 3 years assistant to the president, Swan-Finch Oil Corp., New York, has been appointed domestic general sales manager, Joseph Dixon Crucible Co., Jersey City, N. J. A graduate of Case Institute of Technology, Mr. Zino previously was associated with E. F. Houghton & Co., Philadelphia, for 6 years and Lubri-Zol Corp., Wickliffe, O., for 8 years.

♦ ♦ ♦

Lloyd Canfield, Lloyd Canfield Foundry Supplies, Kansas City, Kans., has been appointed representative there for the Foundry Products Division, Archer-Daniels-Midland Co., Cleveland. Mr. Canfield attended University of Kansas City before entering his father's sand business and established his own company in 1948. He is a director of Mo-Kan Chapter of the AFS and is currently its membership chairman.

♦ ♦ ♦

Alonzo G. Decker, vice president-general manager, Black & Decker Mfg. Co., Towson, Md., has succeeded the late S. Duncan Black as president. **Robert D. Black** has been made vice president and **Glen H. Treslar,** vice president and sales manager of the company.

♦ ♦ ♦

Kenneth A. Tamms, formerly assistant purchasing agent, Ampco Metal Inc., Milwaukee, has joined the sales engineering staff there for the abrasive and diamond wheel department, Manhattan Rubber Division of Raybestos-Manhattan Inc., Passaic, N. J. Mr. Tamms succeeds **Alex Watchorn,** retiring May 1, who has covered the company's Wisconsin territory in Milwaukee for 27 years.

♦ ♦ ♦

Henry M. Laws, foundry consultant, who has been productivity and technical assistance officer for ECA in Europe, with headquarters in the Paris office, recently was assigned to the Special Mission to the Netherlands, with headquarters in the Hague. **Joseph Prendergast** recently was appointed foundry consultant and will make his headquarters at the Paris office of ECA.

♦ ♦ ♦

J. H. Fulford, since 1944 vice president, the Jeffrey Mfg. Co., Columbus, O., has been elected president, succeeding R. W. Gillispie, president since 1930, who has become chairman of the board. **R. H. Jeffrey,** formerly board chairman was named chairman of the executive committee. Other officers named include: **C. J. Leifeld,** executive vice president, and **J. E. M. Wilson,** vice president-manager of the mining division. Directors of the company were re-elected.

♦ ♦ ♦

Chester W. Schweers, for the past year New England manager of general machinery division sales, Allis-Chalmers, Milwaukee, has been named director of division sales. Mr. Schweers has been associated with the company's general machinery sales division for over 20 years. **Merton M. York,** for the past year manager of the Boston office, succeeds Mr. Schweers as manager of the New England region. Recently named division sales representatives are: Duluth, Minn., **Arthur E. Schnaufer;** Davenport, Iowa, **Robert R. Maxwell;** Kansas City, Mo., **R. F. Kinney;** Cleveland, **John T. Petersen;** Cincinnati. **William H. Davis;** Detroit, **William R. Carlyon** and **Clare K. Tubbs;** and Jackson, Mich., **Jack H. Doty.**

♦ ♦ ♦

John R. H. Truelsen, formerly abrasive engineer in the southern Wisconsin territory, Norton Co., Worcester, Mass., has been transferred to the northern Illinois district. **F. Donold Wing,** who has been field engineer in Chicago, has been named to succeed Mr. Truelsen. Both men will work under direction of **Raymond E. Taylor,** Chicago district manager.

♦ ♦ ♦

Mark M. Miller has been appointed sales manager of the Indianapolis plant, National Malleable & Steel Castings Co., Cleveland, succeeding **A. L. McColloum,** who recently retired after over 30 years with the company. Mr. Miller, following graduation from Carnegie Institute of Technology, joined the company's Chicago plant in 1941 and became assistant sales manager in 1948. **John H. Murphy,** who has been in the sales de-

partment since his return from military service, has been made assistant sales manager.

♦ ♦ ♦

William S. DuBois has been named head of the new department of market research recently established by Harbison-Walker Refractories Co., Pittsburgh, for evaluation and development of new and existing types of refractories. Mr. DuBois, a graduate of Central College and a graduate fellow in economics, Vanderbilt University, was formerly senior market analyst, Firestone Tire & Rubber Co., Akron, O.

♦ ♦ ♦

Donald Morton, Charles Myers and **Wagner La Brant,** of Morton-Myers Co., 27 Southwest Blvd., Kansas City, Kans., have been appointed representatives in that area for Werner G. Smith Inc., Cleveland.

♦ ♦ ♦

Donald M. Morrison, formerly associated with the American Fire Clay & Products Co., Canfield, O., and Chicago district blast furnace plants of United States Steel Co., has joined John Mohr & Sons, Chicago, as sales engineer.

♦ ♦ ♦

William E. Harvey, formerly plant manager in charge of carbon and graphite products, has been appointed vice president in charge of production, Speer Carbon Co., St. Marys, Pa. He was previously associated with International Graphite & Electrode Corp., Niagara Falls, N. Y.

♦ ♦ ♦

Dr. Max Hansen has been named assistant chairman of the metals department, Armour Research Foundation, Illinois Institute of Technology. Dr. Hansen joined the foundation two years ago and has been supervisor of projects dealing with nonferrous metals. From 1937 through 1945 he was director of research for Durener Metallwerke, Duren, Germany. Following World War II he completed a compilation of German wartime scientific progress for the U. S. Military Government office in Germany.

♦ ♦ ♦

O. P. Proudfoot, formerly in the Buffalo district sales office, Cutler-Hammer Inc., Milwaukee, has been named manager of the Cleveland district, succeeding the late R. J. Eckstein. Mr. Proudfoot, a graduate of Penn State College, joined the company in 1928. He was engaged in sales work in Pittsburgh and Milwaukee until 1946 when he went to the Buffalo sales staff.

♦ ♦ ♦

T. D. Harter has been appointed eastern district sales manager of the clamshell bucket department, Blaw-Knox Co., Pittsburgh. A graduate of Union College of Schenectady, Mr. Harter will work out of the New York and Philadelphia district office with headquarters in the latter office.

♦ ♦ ♦

Marshall C. Peterson has been appointed assistant general sales manager, Republic Coal & Coke Co., Chicago. He was formerly district sales manager, Franklin County Coal Corp., Chicago.

♦ ♦ ♦

Joseph G. Surmacz has been named chief industrial engineer in charge of production control, Harnischfeger Corp., Milwaukee. He was formerly chief industrial engineer, Ingersoll Steel Division, Borg-Warner Corp., Chicago. **David A. Drewery** has been named his assistant.

♦ ♦ ♦

Dr. Thonet C. Dauphine has been named manager of sales development, Hooker Electrochemical Co., Niagara Falls, N. Y. Since 1946 he has been eastern manager of product development, Oronite Chemical Co., and previously, supervising engineer, California Research Corp., subsidiaries of Standard Oil Co. of California.

♦ ♦ ♦

P. H. Hagen has been appointed representative, with headquarters in Seattle, for West coast sales, Raybestos-Manhattan Inc., Manhattan Rubber Division, Passaic, N. J. A graduate of University of Washington, Mr. Hagen will handle sale of mechanical rubber products and packings in the Pacific Northwest for the West coast sales division.

♦ ♦ ♦

Thomas W. Seaton has been appointed sales engineer, American Silica-Sand Co., Ottawa, Ill. Mr. Seaton joined Allis-Chalmers Mfg., Milwaukee, following graduation from University of Illinois and later was associated with Beardsley & Piper Division, Pettibone Mulliken Corp., Chicago, as sand and service engineer.

♦ ♦ ♦

K. Theodore Korn has been appointed a senior associate, Edward A. Berk & Associates, Cleveland, in charge of management consulting activities. Mr. Korn has done original work in industrial engineering in United States, Canada and many European countries.

♦ ♦ ♦

Seymour Preston, formerly in the sales department, International Nickel Co., New York, has become associated with Alexander Saunders & Co., there, in the sale of equipment and supplies for the industrial precision casting process.

♦ ♦ ♦

Ruth Windsor Grisso has resigned as assistant secretary-treasurer of the Non-Ferrous Founders' Society and will reside at 106 Bailey St., Springdale, Ark. Mr. Grisso is with the Coca Cola Bottling Co., Rogers, Ark.

WILLIAM S. DuBOIS
. . . market research head

DONALD MORTON
. . . Werner G. Smith sales

CHARLES MYERS
. . . core oil sales, Kansas City

WAGNER La BRANT
. . sales, Werner G. Smith Inc.

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Canton, Ohio

Chicago Detroit Pittsburgh Tacoma Seattle
Minneapolis Birmingham San Francisco Los Angeles

SALES AGENTS AND WAREHOUSES:

SAN FRANCISCO AREA—Pacific Graphite Company, Inc., Oakland 8, California.

LOS ANGELES AREA—Snyder Foundry Supply Company, Los Angeles 11, California.

MINNEAPOLIS AREA—Foundry Supply Company, Minneapolis, Minnesota.

MEXICO—Casco S. de R. L., Apartado Postal 1030, Calle Atenas 32-13, Mexico, D. F., Mexico.

SALES AGENTS, NO WAREHOUSES:

NORTHWEST AREA—E. A. Wilcox Company, Arctic Building, Seattle 4, Washington; Phone Mutual 1468.

BIRMINGHAM DISTRICT—Schuler Equipment Company, First National Building, Birmingham, Alabama.

AROUND THE COUNTRY

DETROIT—Foundry operations are effectively choked by shortages of metallics and fuel. Average work week is five days, although most shops now have business on hand to support higher levels. Manpower situation has tightened and is adding to the difficulty. Cry, however, is primarily for skilled help. An organizing drive by the UAW-CIO has been launched, aimed particularly at the foundry industry.

Outlook for new engines in several makes of 1952 auto models is mixed. Report is that the Ford 6 of overhead valve and moderately high compression design, a new Mercury V-8 and a V-8 for DeSoto are assured. There appears a possibility that other Chrysler divisions may introduce new engines; a higher compression 6 for Plymouth is rumored and a V-8 for Dodge. Scheduled increases in production of Chrysler's new FirePower engine are not being realized which scotches rumors that this power plant will presently be available in smaller Chrysler models. One of the major Detroit mysteries is what became of the new Buick V-8 engine program. According to trade sources this engine, which once seemed a possibility for 1952 models, then was rumored for 53s, now appears to be completely forgotten, all its tooling having been lost in the defense shuffle.

Dies for significant changes in next year's bodies have not been blocked by this factor, and nearly all makes will have new lines. Outlook is for greater areas of glass—more of the hard-top coupe's overall appearance. Pontoon-sided car will probably disappear.

NPA order M-68 setting passenger car output at approximately 1.2 million units for third quarter if necessary materials can be scraped together, indicates that a good case has been made by the industry for continuing production in substantial volume. Sales slowness will undoubtedly be as much a governing factor as materials availability for some makers through the summer. Should supply of steel, copper and aluminum be too low for industries not under the CMP umbrella after its operation for a while, automakers have been told they can expect coverage.

General Motors' metallurgical research laboratory and experimental foundry at its new technical center here are expected to be occupied and in operation late this year.

Defense Orders Expand West Coast Backlogs

Los Angeles—Growing volume of DO business is expanding foundry defense work backlogs. One steel foundry upped its DO backlog to 50 per cent from 20 per cent within 60 days. The biggest single source of defense work for West coast foundries is the Food Machinery Corp. tank program and almost all West coast steel foundries are participating. Food Machinery's San Jose plant, employing more than 9000 persons, is at the tooling-up stage, but castings have already been shipped from this area.

Another important source of DO work, but almost exclusively nonferrous, is southern California's booming aircraft industry. Backlog of Douglas, Lockheed, North American and Northrop recently touched $2.5 billion. Employment at their ten local plants is 105,000. Aluminum foundries are booked to capacity for the next four months from this quarter.

Not all foundries, however, are getting as much defense business as they would like. Some are encountering spotty demand for castings due to delays in conversion of their customers' plants. One nonferrous foundry operating at 80 per cent previously, is down to 60 per cent; it expects to go lower. Foundries supplying the unrated natural gas industry, plumbing and petroleum industries generally have DO backlogs ranging from ½ to 5 per cent, and are hampered severely in getting raw materials. For these foundries the big question is: Will defense work come soon enough?

Materials and labor shortages are both major headaches and foundrymen have trouble deciding which is No. 1. One iron foundry currently at 80 per cent capacity could increase operations to 100 per cent if able to get molders. The long and expensive freight hauls by land and water necessary to obtain supplies of coke, pig iron and scrap hamper district foundries and boost their costs. Recent shipments of scrap from Honolulu were $63 per net ton, freight included. Coke is selling for $31, including $10 freight. In the opinion of industry observers high freight charges coupled with high overhead pegs production costs for West coast foundries 10 to 15 per cent above those of eastern foundries. More mechanization, they say, may be the answer to higher production costs by making possible greater use of lesser skilled workers. However, they point out, the small runs typical of this area, allowing only a few semi-production shops, hampers the widespread employment of mechanization.

Construction of the $1 million American Brake Shoe Co. foundry in Pomona has started. It will be one of the largest foundries on the West coast.

Chicago Foundries Expect Upturn in Rated Orders

Chicago—Best estimates are that rated orders for nonferrous and gray iron castings do not average much over 20 per cent of current production in this area. In the case of nonferrous, the volume could expand sharply in the next few weeks, but there is no similar prospect for gray iron.

Nonferrous shops as a whole are running about 60 per cent of capacity, based on a one-shift 8-hour day. The rush of orders anticipated has not developed and is attributed to the delay of OPS in formulating and announcing pricing procedures. Once price regulations are issued, it is expected a flood of orders will be loosed. Minimum set-asides for rated orders for nonferrous castings are 75 per cent (90 per cent for beryllium copper) but few shops approach this level.

Minimum set-aside for gray iron castings for defense account was recently upped from 20 per cent to 60 per cent for plain castings, 65 per cent for full alloy types and malleable iron and 75 to 80 for steel. Now and then instances are heard of a defense item manufacturer unable to contract for castings supply, but this should

(*Concluded on page* 117)

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Smooth, plastic fire clay with good refractoriness and low drying shrinkage. Ground and screened to about 12 mesh with particle sizes ranging downward to micron size. Most widely used ground fire clay on the market.
GOOSE LAKE FIRE CLAY FLOUR
Extra fine clay for bonding sand, laying fire brick and for mixing cupola and ladle linings. Finely pulverized, works readily with water, spreads easily.
GRUNDITE BOND CLAY
For bonding foundry molding sands—especially malleable, hard iron and light to medium grey iron castings. Grundite bonded sands improve casting finish, reduce scrap and help produce castings closer to pattern size.
GOOSE LAKE SILICA MIX FOR CUPOLA PATCHING
Made with Goose Lake Fire Clay and angular silica, ground and screened to produce a dense lining with high resistance to slag and erosion from the charge. High adherence for manual or gun application.
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- MALCOLM G. STEVENS Arlington, Massachusetts
- PACIFIC GRAPHITE CO., INC. Los Angeles 22, California
- QUEEN CITY SAND & SUPPLY CO. Buffalo 7, New York
- ST. LOUIS COKE & FOUNDRY SUPPLY CO. *(formerly M. W. Warren Coke Co.)* St. Louis, Missouri
- WESTERN FOUNDRY SAND CO. Seattle, Washington
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INDUSTRIAL OILS DIVISION . . . ROCKFORD, ILLINOIS

(*Concluded from page* 114)

not hold true under the larger reserve for rated orders.

Gray iron foundries here are operating at 70 to 75 per cent of capacity. Manpower—particularly in the skilled category—is bordering on the critical and is as much a hold-down on production as raw material supply. During the past year, improvements in operating conditions—for example, more mechanization and installation of more modern molding and core making equipment—have tended to offset shortages in manpower. So castings output has increased without much expansion in working forces. Deliveries on castings range from 60 to 90 days, about the same as last fall.

While pig iron is not available in quantity desired, it appears to have become no more critical than two or three months ago. There seems to be no possibility, short of government allocation, for an increase in foundry iron supply so long as bulging operations of steel mills require maximum amounts of hot metal from blast furnaces. Suppliers of pig iron still are credited with doing a first-class job in allocations to foundries and shipments are well scheduled. The same applies to coke.

All grades of foundry scrap are extremely scarce and afford little opportunity to make up pig shortage. Steel rails are particularly tight. In Milwaukee a well-organized scrap drive is under way and is producing good results. Nothing comparable to this effort has been started in the Chicago area.

Pig Iron Supplies in Eastern Area Shrink

Philadelphia—Despite the shortage of raw materials, district iron foundries have been able to maintain operations at around five days a week. A few have been forced to curtail but they are the exception. However, operators are keeping their fingers crossed, particularly in view of the increasing stringency in pig iron.

Shipments of iron from one Buffalo producer are being seriously curtailed and those from the Swedeland, Pa., producer also are off. This latter is ascribed to ring trouble at the smaller of the two furnaces at that point and before June is over melt will be suspended completely for at least three or four weeks. Meanwhile, less reliance is being laid on foreign supply.

Iron foundries have been forced to depend largely on cast scrap for which, in many cases, they have had to pay top prices on questionable material. Steel casting producers are confronted with considerable more demand than they can supply, backlogs running 16 to 18 weeks. Malleable producers likewise are running behind on shipments but have been able so far to maintain a high average operating rate, even though it is touch-and-go in obtaining sufficient melting materials.

It is estimated that malleable and steel foundry bookings include about 50 per cent DO-rated orders and that operations of gray iron foundries involve no more than 10 to 15 per cent. Nonferrous foundry operations, however, are comprised almost entirely of DO-rated work.

While the draft has not as yet had much effect on manpower supply in general, the calling up of officers in the reserve for both the Navy and Army has meant the loss of valuable men in the managerial and metallurgical departments of some companies.

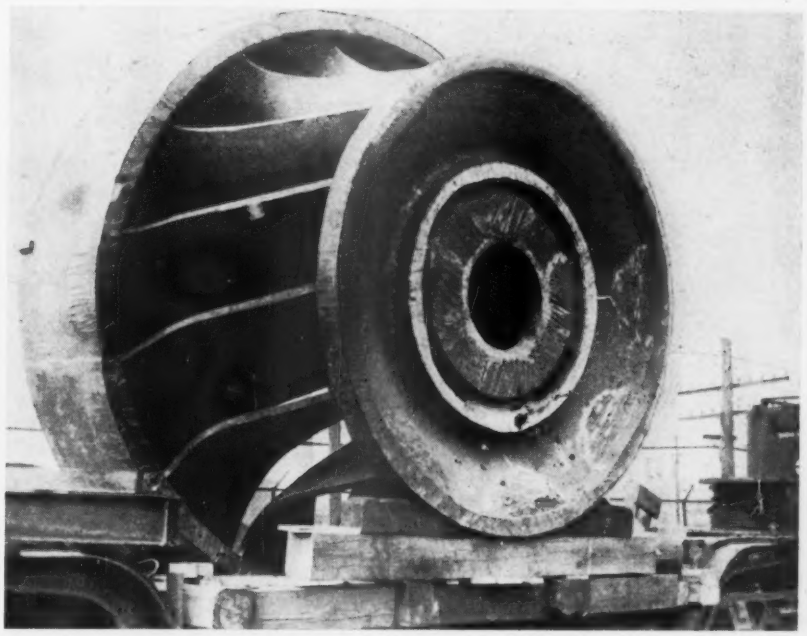
State Foundry Inc. has been incorporated in New York state. Directors are George W. Gallien, 397 State St., and Eleanor Climenko, 54 North Pine Ave., Albany, and John F. Kelly, 184 Remsen St., Cohoes, N. Y.

Contract Renegotiation

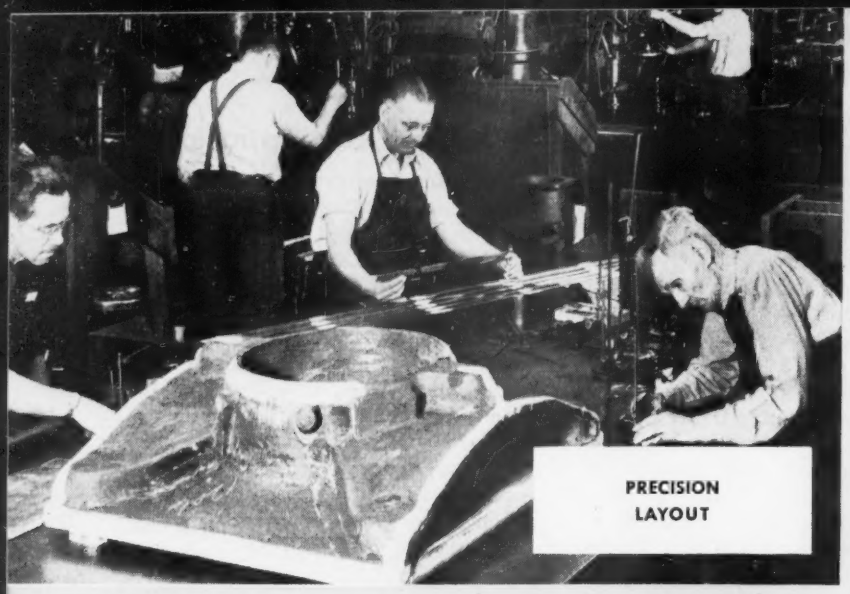
"The Defense Program and Contract Renegotiation," published by Machinery & Allied Products Institute, 120 South La Salle St., Chicago 3, presents results of a study of the theory and operation of contract renegotiation and offers a philosophy of the role of this device in procurement policy which is believed to be sound for industry and government. A summary of recommendations presented by George Terborgh, institute research director, before the Senate finance committee is included. Price is 25 cents.

Elects New Officers

International Acetylene Association, at its annual business meeting and convention in Montreal, Que., May 21-23, elected James W. Dunham, National Cylinder Gas Co., Chicago, president, and F. W. Hench, American Oxygen Service Corp., Harrison, N. J., vice president. E. V. David, Air Reduction Sales Co., New York, was re-elected treasurer, and H. F. Reinhard was re-elected secretary.



TRANSPORTATION PROBLEM: This 165,000-lb, 17-ft. 4-in. steel turbine runner was cast in one piece by Erie Forge Co., Erie, Pa. Its shipment to Newport News Shipbuilding & Dry Dock Co., Newport News, Va., for machining and installation in a hydroelectric turbine unit for a new power plant on the Roanoke river presented a transportation problem because of railroad right-of-way clearance requirements. Engineers, co-operating with the Pennsylvania Railroad, solved the problem by suspending the casting on a structural steel cradle mounted between two flat cars. Loaded in this manner, with its lowest point only 6 in. above the rails, the casting was moved as a special train during daylight hours, at a maximum speed of 15 mph



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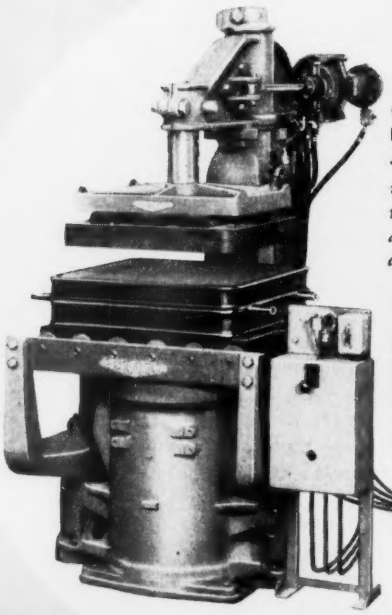

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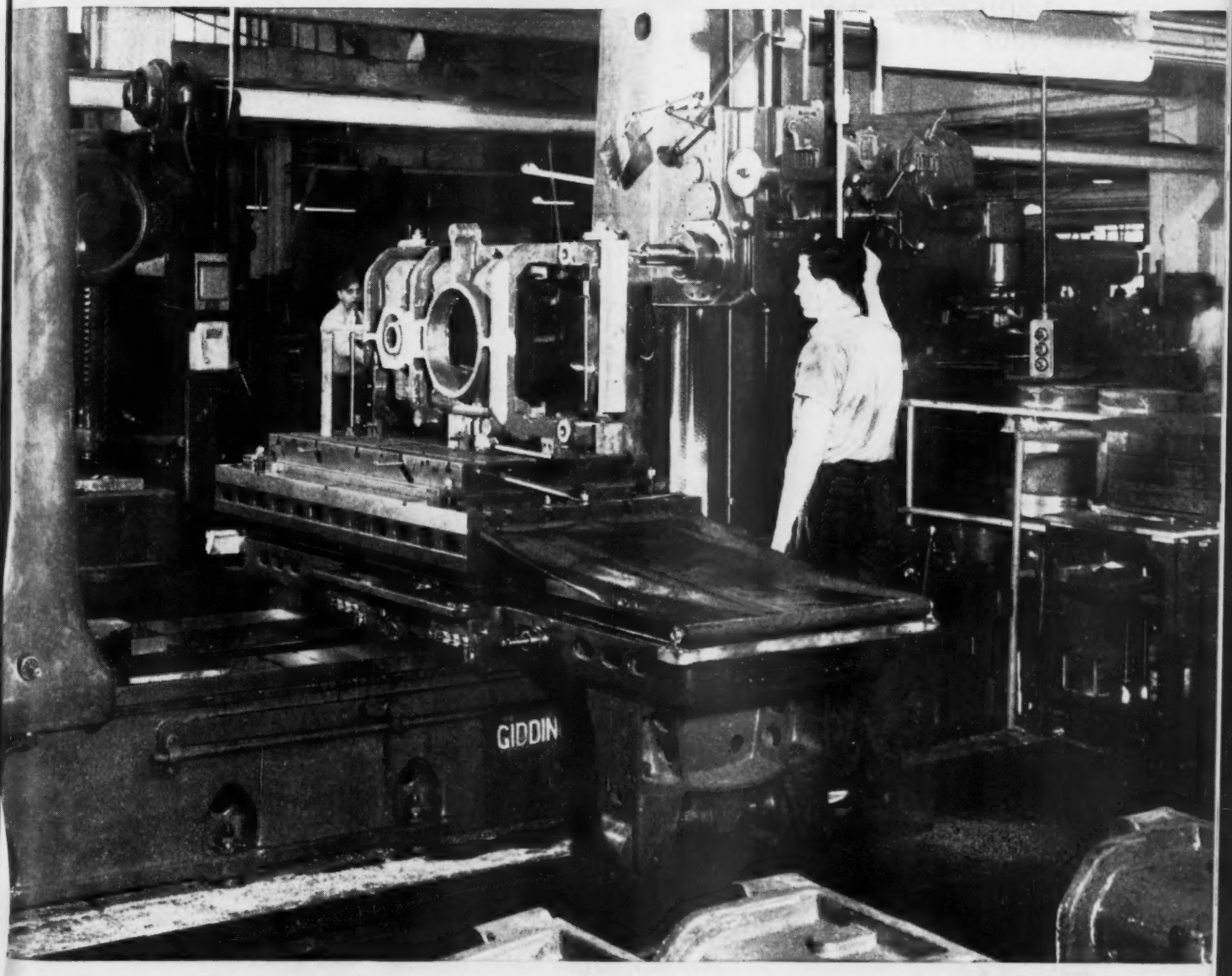

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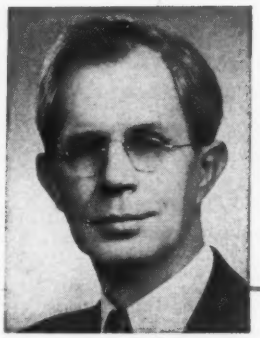
MAN-TO-MAN

on the Molder's Bench

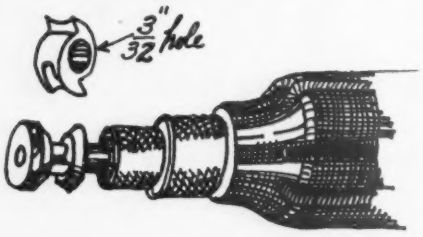
"Confessions of an Amateur Patternmaker"



By RALPH L. LEE

EVERY once in a while I thumb my nose at duty up there in the Lee Hobby Foundry pattern shop and, against all logic and reason, cut loose and do just as I darned please. I'm not recommending this self indulgence, you understand; I'm confessing it and a little bit ashamed of not feeling as guilty as I should. But confession is good for the soul, as the saying goes.

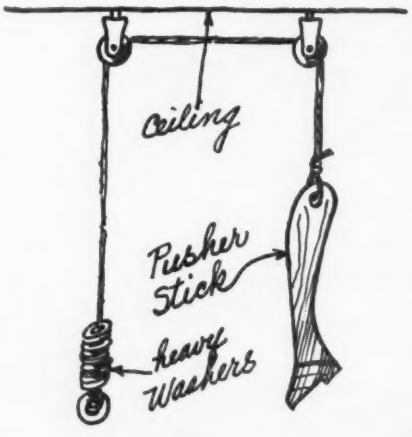
Some time ago I was working on a pattern—not exactly a rush job, but one that had to come along to keep one of the major projects moving. I was putting a radius on what seemed to be an endless string of sharp corners. I had a little template and was trying to do a good job with knife, sort of a little spoke shave, and sandpaper. Every once in a while, the grain would fool me and I'd let slip a few mild cuss words under my breath. While this was going on I was being haunted by the thought of a little radius cutter which would fit into one of these highly advertised buzz motors with 57 little burrs, wheels and buffers. The folks gave me one of these general utility mo-



tors for a birthday present some years ago and I have been trying since to find something I can use it for.

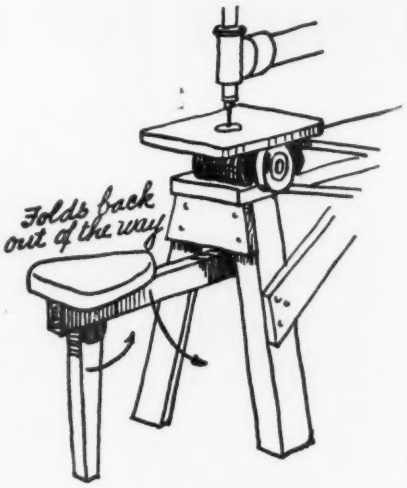
I finally reached the point where I couldn't stand the haunting any longer so here is what I did. I went down in the machine shop (that's plant No. 2 in the basement; we live over it) and made this little cutter. Here's a sketch of it. Guess this was my lucky day, for it worked swell the first time—it was for about $\frac{5}{64}$-in. radius. When I get around to it I'm going to make a set of different sizes.

Then take one day when I was ripping some pattern lumber (short



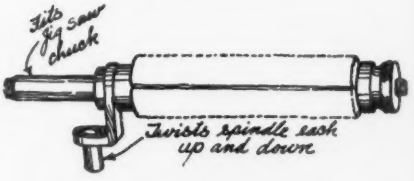
pieces). I was forever mislaying the pusher stick my son showed me how to make. The old haunts got me again, so neglecting my duty I made a Goldberg rig which I'll betcha will keep me from mislaying that stick again. There's a sketch of it here.

I don't have a bandsaw, only a jigsaw. Maybe I shouldn't mention this, for I don't believe I've ever seen one in the dozens of legitimate pattern shops I've visited. I've kinda' felt that maybe I have lost caste by using a jigsaw, but being only an amateur I imagine folks will understand. But anyway, having had bifocals for these many years, I've got to sit down to see close work I'm doing. Whenever this happens I've got to chase around to find the stool. I got sick and tired of being haunted by the thought of a folding seat, something on the or-



der of a bicycle saddle, so I gave into the haunt, neglected my job and made one like the sketch here. Believe me I blushed as I worked on it—but I'll tell you this, now that I have it I wouldn't want to do without it.

I don't know if I will ever be able to afford a spindle sander; I doubt it, for with the kind of jobs we do in the Lee Hobby Foundry I'd have to beat my financial conscience to a pulp to justify the money it would cost. With sandpaper wrapped around different dowel rods rubbing away at this radius and that, another haunt clomped down on me. Again I fell to



the sirens call and whipped me up a spindle sanding attachment for the jigsaw. By golly, I think we've got something. Here's a sketch of the thing-a-ma-bob. The little arm sticking out from the unit fits into sort of a Yankee screw driver cam slot in a piece I fastened underneath the table. The trick I'm proudest of is being able to fasten sheets of sandpaper on the spindle, good and tight. Don't have to make sandpaper tubes.

Here's one for good measure—this little tin can, with a small round lamp bulb for keeping the bottle of cold (?) glue at just the right temperature to go on the work smooth and nice. I have found that there are

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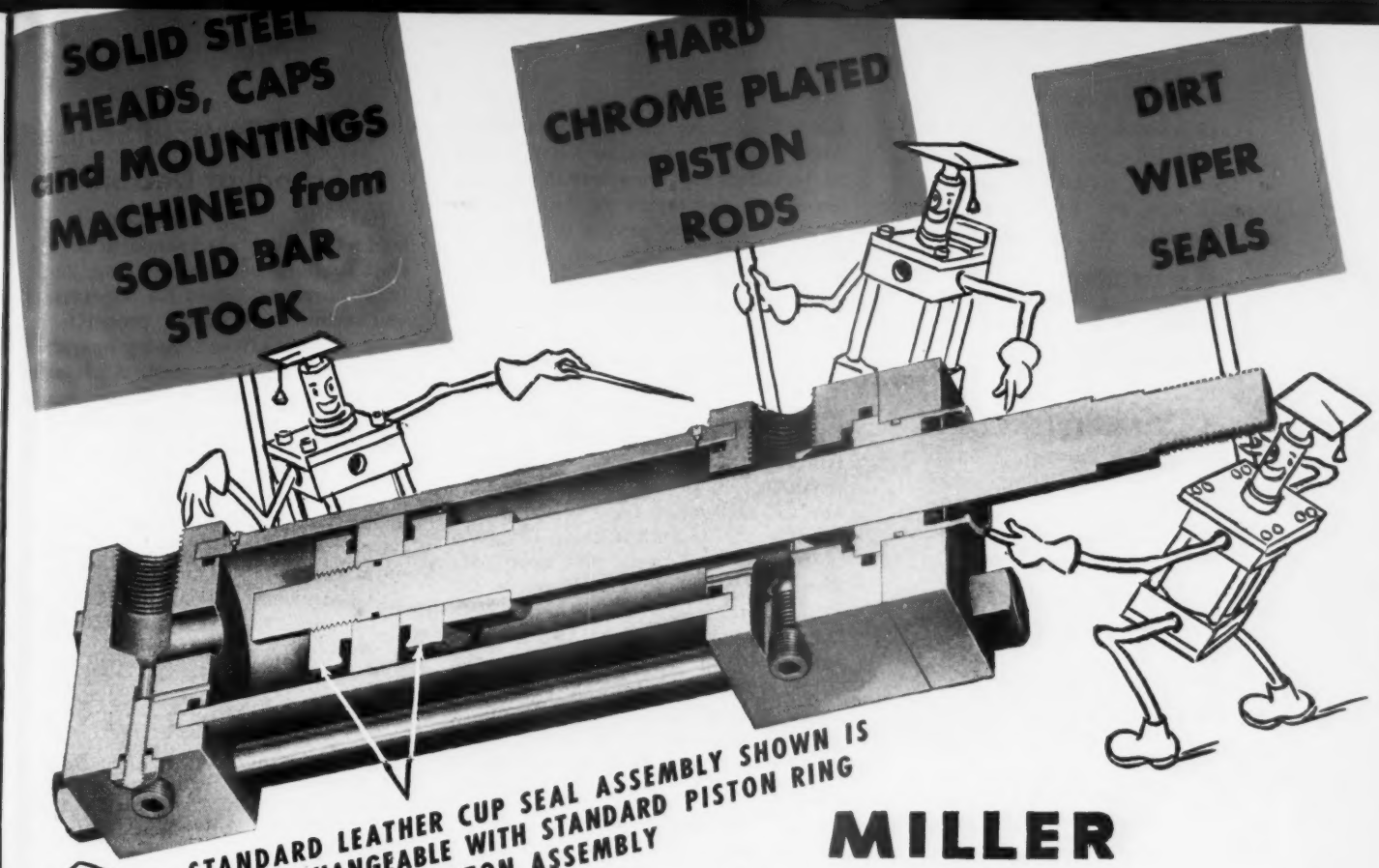

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ST. LOUIS and OTHER AREAS.

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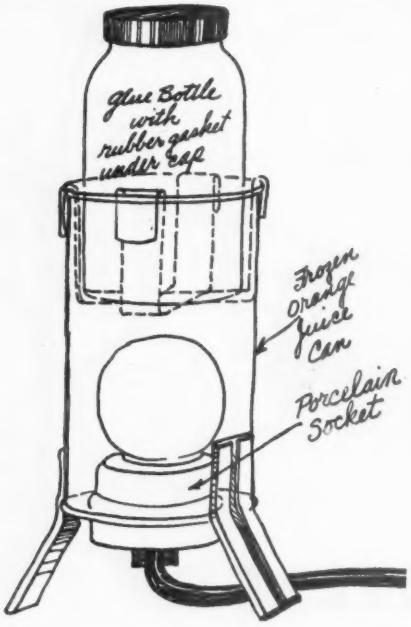
just about as many ideas about glue as there are patternmakers, so I guess I can get by warming cold glue, the kind that comes in cans I



mean. You see, I'm away so much of the time.

I realize, of course, that you can carry this matter of confessing your sins to the point of plain unadulterated bragging. But little by little I'm getting the pattern shop in such a shape that I won't have to move anything to get at something else, where the things I use the most are within easiest reach and where I don't have to do things the hard way. This isn't because I am trying to be virtuous or miserly when it comes to spending or wasting time. It's just that I get a bang out of seeing ways to do things better and easier and rigging up to get them into effect.

I have said it before and I'll say it again that patternmaking is in a class all by itself. It's a magic craft where dreams can be made to come true, both good and bad, where steel, iron, bronze, brass, aluminum, magnesium and what have you can be cut like cheese with a knife. Doggone it, sometimes I think that good patternmakers are too often taken for granted; they pull rabbits out of hats as a matter of course. And I'll say this too—just get out there on the bench some day, take a print and start from scratch to whittle out a job; if you haven't had any experience you'll soon find out how much there is to this fine craft, I'll betcha.

The other day I looked at some of the patterns I made 15 years ago. I couldn't believe it, and I imagine if I live long enough to look back even five years from now on the ones I'm working on today I won't believe it either. It might not be a bad idea for all of us (who don't have to) to visit the pattern shop now and then; it will cheer them up and we'll get something out of it besides a Boy Scout feeling.

Dietert To Hold Sand School at Detroit

Harry W. Dietert Co., Detroit, will hold a three-day sand school at the Detroit Engineering Society, Aug. 20-22. In a course developed for supervisory and technical personnel, properties of sand as they affect foundry operating costs will be considered. A detailed study will be made of foundry sands' structural, green, air-set, dry, hot and retained properties and how each affects the ease of working the sand in reference to manual effort and supervision required. Illustrations on how to control the various properties of a sand will be included. Lectures will be given by Frank S. Brewster of the Dietert company and there will be no charge for attendance.

Book Review

ASTM Manual on Quality Control of Materials, paper, 128 pages, 6 x 9 in., published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3. Price $1.75.

This new manual replaces the widely used *ASTM Manual on Presentation of Data.* It is composed of three sections of which the first relates to presentation of data. The second presents limits of uncertainty of an observed average and the third part explains the control chart method of analysis and methods for presentation of data.

Meetings of Interest to Foundrymen

July 23-27—American Association for the Advancement of Science, research conference, New London, N. H.

July 27—Malleable Founders' Society, western sectional meeting, Drake Hotel, Chicago

July 30-Aug. 2—American Electroplaters' Society, convention, Statler Hotel, Buffalo

Sept. 10-14—International Foundry Congress, Brussels, Belgium

Sept. 10-14—Instrument Society of America, conference and exhibit, Sam Houston Coliseum, Houston, Tex.

Sept. 24-25—Steel Founders' Society of America, fall meeting, The Homestead, Hot Springs, Va.

Oct. 11-12—Michigan Regional Foundry Conference, Michigan State College, East Lansing, Mich., sponsored by Michigan chapters, AFS, and the college.

Oct. 15-19—American Society for Metals, annual meeting and exhibit, Michigan State Fair Grounds, Detroit

Oct. 19-20—Texas Regional Foundry Conference, Texas Chapter of the AFS, Shamrock Hotel, Houston, Tex.

Oct. 25-26—Gray Iron Founders' Society, annual meeting, Edgewater Beach Hotel, Chicago

Oct. 31-Nov. 2—Foundry Equipment Manufacturers' Association, annual meeting. The Homestead, Hot Springs, Va.

Nov. 1-2—Metals Casting Conference, sponsored by Purdue University with Michiana and Central Indiana AFS chapters, Purdue University, West Lafayette, Ind.

Nov. 7-9—Meehanite Casting Manufacturers, annual meeting, the New Yorker, New York

Nov. 7-9—National Foundry Association, annual meeting, Shoreham Hotel, Washington

Nov. 8-9—Quad City Regional Foundry Conference, Blackhawk Hotel, Davenport, Iowa

Nov. 8-10—Steel Founders' Society of America, Technical and Operating Conference, Carter Hotel, Cleveland

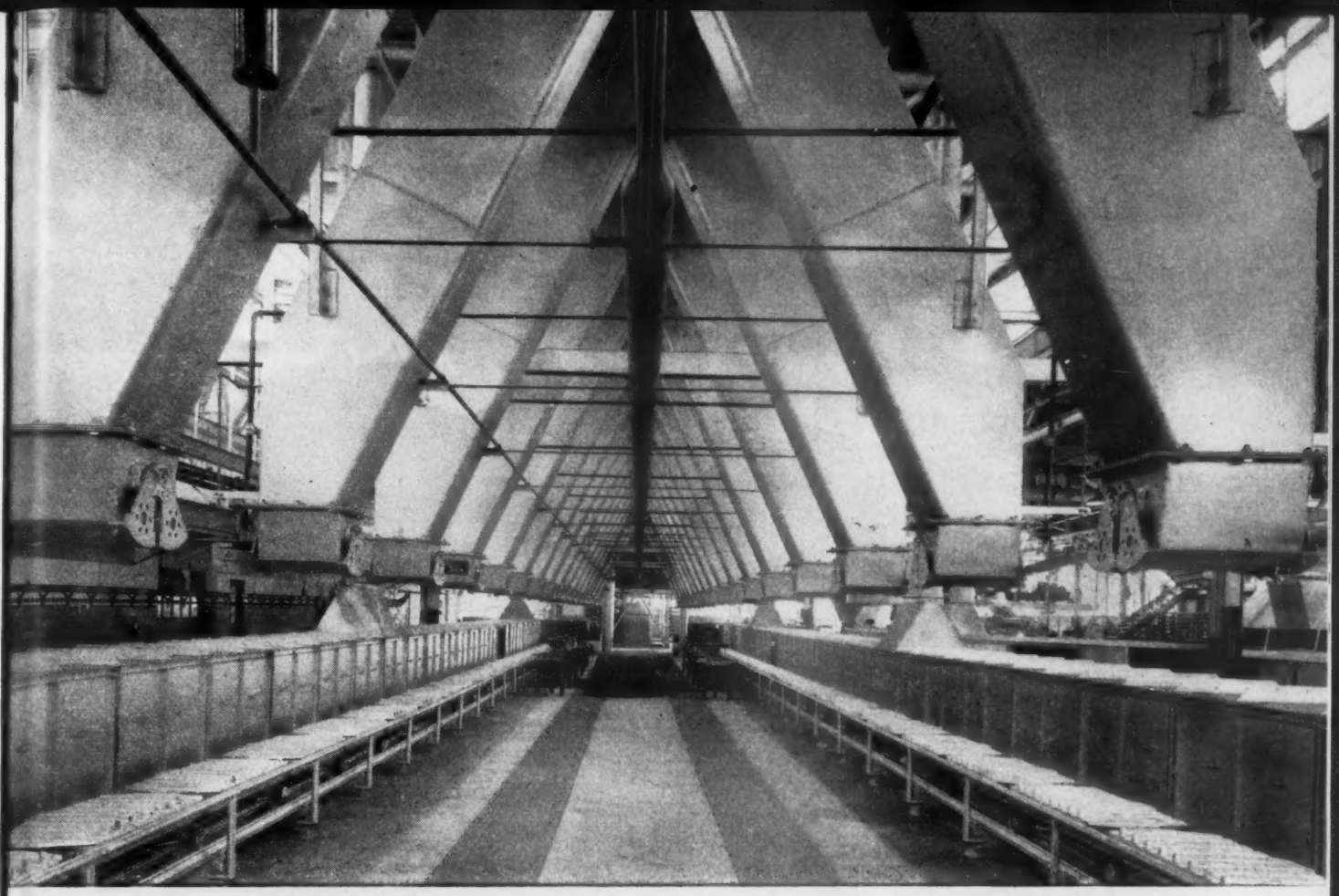
Nov. 15-16—Magnesium Association, annual meeting, Biltmore Hotel, New York

Dec. 6-8—American Institute of Mining and Metallurgical Engineers, Electric Furnace Steel Conference, Hotel William Penn, Pittsburgh

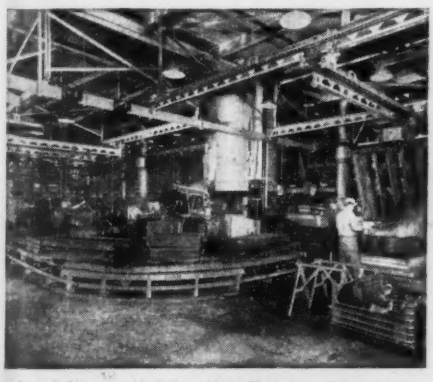
1952

Feb. 21-22—Birmingham Regional Foundry Conference, Birmingham District Chapter and University of Alabama Student Chapter of the AFS, Tutwiler Hotel, Birmingham

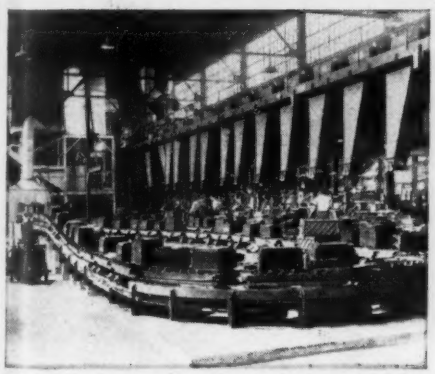
May 1-7—American Foundrymen's Society, annual convention, Atlantic City, N. J.



Above: Molder's Hoppers and Continuous Mold Conveyors in Large Mid-Western Foundry.



Sand Slinger Molding Unit Showing Continuous Mold Conveyor and Side Wall Shakeout.



Mechanized Jobbing Foundry Equipped with Car Type Mold Conveyor.

Mechanization

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● Mechanization synchronizes and coordinates all operations in the foundry. It minimizes bottlenecks, delays and lost time. Output per unit of floor space is much increased. Lost molds and reject castings are much reduced. Foundries become better, cleaner, healthier places in which to work, attract a higher grade of workmen. Labor turnover is reduced and casting costs are cut, sometimes by as much as 33⅓%.

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RINDING WHEELS SPEED PRODUCTION

Tailor-Made to the Particular Needs of Your Job, These Superior Abrasive Units Solve Difficult Production Problems Accurately . . . Economically!

STERLING'S Research and Development Program now offers you specific-purpose portable wheels, custom-made to the grinding demands of your casting jobs. Whether your problem is the grinding of malleable, grey iron, steel, aluminum, brass, or copper, there is a "Wheel of Industry" with pre-determined performance records to assure a super-smooth, free-cutting abrasive unit that provides extra hours of service.

Sterling's plastic bushing – now standard on all straight portable wheels – assures a perfect fit on the spindle because of the smooth, highly polished surface. It helps create a shock-free grinding tool with minimum vibration . . . insures ease of grinding . . . provides something extra at no added cost.

Available in a wide selection of grain combinations and bonds, Sterling's straight and flaring cup portable wheels, built to the exact demands of your job, assure superior results. This we will gladly prove by a test run under any conditions you may select. Your letter will bring a Sterling engineer at your convenience.

BEST IN THE TEST --- THAT'S STERLING

In a test in a well known automotive plant, a Sterling straight portable wheel, 6 x 1 x 5-8, was given stringent snagging tests in competition with other wheels. Used on automotive castings, this specification, JA164 QB B2595, cut very fast and free, giving exceptional wheel life. The customer considered this "Wheel of Industry" one of the best ever used on this type of work and re-ordered them.

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Here is a series of folders which will provide widespread information on various types of grinding. Complete data is available regarding the correct grinding wheel to use with various machines and metals. This important group of folders, which includes the popular "Art and Science of Grinding," will be sent upon request at no obligation.

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Technical Reports

—AFS CONVENTION

Concluding reports on technical sessions held during the annual meeting of AFS in Buffalo are presented here. Reports on heat transfer, aluminum and magnesium, malleable iron, plant equipment and sand sessions were published in the June issue

ELEVEN technical papers comprised the program at four sessions sponsored by the Gray Iron Division at the recent AFS convention in Buffalo. A roundtable luncheon and evening shop courses completed the division's events.

Three papers dealing with the influence of certain elements and of temperature on the physical properties of nodular cast iron were presented at the opening session under the joint chairmanship of A. P. Gagnebin, International Nickel Co., New York, T. E. Eagan, Cooper-Bessemer Corp., Grove City, Pa., and W. B. McFerrin, Haynes Stellite Division, Kokomo, Ind.

Change Graphite Form

The first paper, "Influence of Silicon Content on Mechanical and High Temperature Properties of Nodular Cast Iron," by W. H. White, L. P. Rice and A. R. Elsea, was presented by Mr. White, metallurgist, Jackson Iron & Steel Co., Jackson, O. Mr. Rice is research engineer and Mr. Elsea is assistant supervisor, Battelle Memorial Institute, Columbus, O. Despite good high-temperature properties, the useful applications of high-silicon cast iron in the past have been limited because the material is brittle at room temperature. Recent development of nodular iron, with its increased tensile strength and ductility, suggested to the authors that it might be possible to improve considerably the ductility of high-silicon cast irons by treating them to form spheroidal graphite.

Results of experiments indicated that spheroidal cast irons containing 4 to 5 per cent Si have sufficient impact resistance to overcome the objection to high-silicon irons of extreme brittleness. Strength, scaling and growth properties also were improved. The paper provoked considerable discussion in which several speakers claimed their investigation led to different results.

In the second paper, "Effect of Phosphorus Content on Mechanical Properties of a Nodular Cast Iron," by J. E. Rehder, foundry engineer, Physical Metallurgy Division, Mines Branch, Ottawa, Ont., the author claimed that increasing the phosphorus content of nodular iron from a low level results in slightly increased strength, and more or less seriously decreases elongation and impact strength. In the as-cast state the elongation and impact strength drop rapidly as phosphorus content is increased, decreasing by about one-half for every doubling of the phosphorus content in the iron tested. For maximum ductility as cast, phosphorus content of nodular iron must be low. In the fully annealed (completely ferritic) state a higher phosphorus content is tolerable than in the as-cast state. This tolerable level is increased by annealing from a temperature sufficiently high to spheroidize phosphide eutectic. For the irons tested, the permissible phosphorus content is estimated at 0.12 per cent if annealed from 843° C (1550°F, and 0.16 per cent if annealed from 954° C (1750°F).

In the oil quenched and drawn state for the irons tested, an optimum phosphorus content apparently exists below which ultimate and yield strength decrease rapidly and above which elongation and impact strength decrease less rapidly. For the irons tested, increasing the phosphorus content by three times decreases the elongation and impact strength by about one-third of the former value. For the irons tested, the maximum solid solubility of phosphorus, above which free phosphide eutectic appears, is estimated as 0.08 to 0.10 per cent phosphorus. This coincides with the optimum phosphorus content for the same irons in the oil-quenched and drawn (1150° F) state. Phosphorus apparently retards graphitization, at least in and below the critical temperature range.

The first half of the third paper, "Some Effects of Temperature and Melting Variables on Chemical Composition and Structure of Gray Iron," was presented by E. A. Lange, graduate student, Department of Mining and Metallurgy, University of Wisconsin. Second part of the paper was presented by R. W. Heine, assistant professor Metallurgical Engineering University of Wisconsin. The paper gave results of a study of some fundamental melting phenomena that direct the course of composition and structural changes in gray cast iron. Variables studied include air oxidation of the iron in various refractories, effect of temperature, influence of slags, iron oxide, rusty scrap, coke, and the results of melting under a CO atmosphere.

At the second gray iron session the official exchange paper from the Institute of British Foundrymen, "Basic Cupola Melting and Its Possibilities," was presented by its author, E. S. Renshaw, Ford Motor Co., Dagenham, England. Second paper at the session, "Effect of Slag Analysis on Cupola Operation," prepared by R. A. Flinn and R. W. Kraft, American Brake Shoe Co., Mahwah, N. J., was presented by Mr. Flinn. Max Kuniansky, Lynchburg Foundry Co., Lynchburg, Va., presided, with Gosta Vennerholm, Ford Motor Co., Dearborn, Mich., as co-chairman.

Slag Chemistry Important

Mr. Renshaw described his experience with a basic-lined cupola in production operation. He stressed the importance of slag chemistry in cupola melting, stating that in acid practice, slags are considered a necessary evil, whereas basic slags permit reduction of sulphur and increase carbon pickup in charges. Silicon losses, however, are greater. Particular reference was made to nodular iron production in discussing the advantages of these factors.

Additional refractory costs for basic cupolas as compared with acid cupolas, according to the speaker, may be justified in the case of nodular iron production if subsequent processing cost is lowered by reducing alloy additions used in ladle treatment. Mr. Renshaw also discussed the use of water-cooled cupolas for reducing refractory erosion, permitting operation with slags of higher basicity.

Discussion brought out the fact that melting control is generally more difficult with a basic cupola, and a large receiving ladle was recommended to even out differences in the iron. It also was stated that basic cupolas achieve higher temperatures than

(*Continued on page* 128)

it's a time for pinching ALLOYS

MOLYBDENUM

as an alternative to Tungsten, Nickel, and other scarce, imported elements, is subject now to extraordinary demands beyond its normal uses, and must itself be economized.

TUNGSTEN

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which is abundant, serves as an extender of all these essential alloying materials. It is used very advantageously in combination with Molybdenum. In the form of Ferro-Boron, it can be employed with no change of equipment or plant procedure. It improves the quality of rolled steel—cast steel—high-speed tool steel—cast iron—malleable iron—alloyed welding rods—other ferrous products.

The Molybdenum Corporation has been a pioneer in the improvement and a leader in the production of Boron alloys. A most economical and practical form in which Boron can be introduced is a Ferro-Boron (U. S. patents 2,283,299 and 2,509,281) developed by MCA through long research. The company gladly offers its technical and practical experience to aid any user of Molybdenum, Tungsten, or Boron. Full data on request.

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MOLYBDENUM CORPORATION OF AMERICA
Grant Building Pittsburgh, Pa.

MCA

(*Continued from page* 126)
acid cupolas on a given quantity of coke.

In his presentation, Mr. Flinn stated that slag is the heart of the melting process in basic cupola operation but is considered a necessary evil in acid cupola operation. Basic slag doesn't wet coke as much as acid slag and therefore carbon pickup remains good as melting operation continues. Carbon pickup decreases as melting proceeds in the acid cupola because acid slags coat the coke.

He went on to say that highly basic slags are gummy and require high temperatures to keep them fluid. With a given slag, however, higher temperatures produce irons with higher phosphorus content. To keep phosphorus in the slag, high iron oxide is required. Such a slag, however, attacks cupola refractory linings, although Mr. Flinn pointed out that amounts of iron oxide beyond 2 per cent have little additional effect.

Removal of sulphur from the metal is greater with a highly basic slag and low iron oxide content. The latter condition is achieved by having sufficient slag volume and a fluid slag brought about by high operating temperature or by fluidizing additions. The speaker has used calcium fluoride to obtain a fluid slag. It is added in the form of lumps to prevent finer material from blowing out the stack. Additions should be sufficient to maintain 2 to 3 per cent of the fluidizer in the slag.

Mr. Flinn also stated that silicon loss is light in basic cupola melting.

Because of the many factors involved, the speaker pointed to the necessity of compromising slag compositions to meet specific requirements and emphasized the need of closer supervision in basic cupola operation.

With V. A. Crosby, Climax Molybdenum Co., Detroit, and R. Schneidewind, University of Michigan, presiding, three papers were presented at the third gray iron session. "Structure and Mechanical Properties of a Mo-Ni-Cr Cast Iron," was presented by Edward A. Loria, Carborundum Co., Niagara Falls, N. Y. Information was given on microstructure and mechanical properties of 1.2-in. diameter bars of a gray iron containing 2.77 per cent total carbon, 1.40 per cent Si, 1.40 per cent Mo 1.00 per cent, Ni, 0.50 per cent Cr as cast, after tempering at 400, 600 an 700°.

Matrix was a mixed structure consisting mainly of acicular ferrite and a dark-etching network pattern of low temperature transformation products (lower bainite and possibly martensite) arising from dendritic segregation of alloying elements. An as-cast tensile strength of 72,500 psi with a transverse strength of 5600 lb and accompanying deflection of 0.48 in. was obtained. Tensile strength was raised to 98,300 psi upon tempering. Mechanical test data show that this acicular iron has an as-cast and reheat strength that is comparable with the best of the acicular irons now in use. Improvement was brought about by removal of any retained austenite and tempering of lower bainite (martensite) structures, it was believed.

The second paper, "Isothermal Transformation Characteristics on Direct Cooling of Alloyed White Iron," by F. B. Rote and G. A. Conger of University of Michigan, and K. A. DeLonge, International Nickel Co., Bayonne, N. J., was summarized by Mr. Rote. Results were given of an investigation of the isothermal transformation characteristics of an alloyed white iron containing nominally 3.40 TC, 1.15 Si, 0.35 Mn, 4.50 Ni, 1.85 Cr, and 0.12 Mo. A complete T-T-T diagram was determined from data obtained by hardness tests and microscopic examination of wedge-shaped castings, directly air-cooled from the mold to sub-eutectoid temperatures for isothermal transformation. Diagram for the iron has two "knees," one at 500° F, the other at 1000° F. Time required for beginning of transformation was 1.3 hr at 1000° F and 1.4 hr at 500° F. Transformation was complete in 6 hr at 1000° F and in 32 hr at 500°F.

Conditioning Has Marked Effect

The T-T-T diagram is directly applicable to small castings, but requires alteration for large castings which cool slowly. Such alterations can be based on supplementary data secured in the investigation of conditioning treatments. Conditioning by slow cooling or by soaking at an elevated temperature (1400°F in this investigation) has a rather marked effect on the transformation characteristics.

Third paper, "Kinetics of Graphitization in Cast Irons," by B. F. Brown and M. F. Hawkes, North Carolina State College of Agriculture and Engineering, was presented by Mr. Brown. Gamma-range graphitization, eutectic reaction and subcritical graphitization were the subject of the study. In his development of gamma range graphitization the speaker dis-

(*Continued on page* 130)

New Powder-Washing Method Cleans Castings

SAND encrustations, fins, pads, chaplets, or chill nails are said to be removed from castings by a new method known as powder-washing. Developed by Linde Air Products Co., Division of Union Carbide & Carbon Corp., 30 East 42nd St., New York 17, the apparatus consists of an oxy-acetylene blowpipe equipped with external powder-washing attachment. An iron-rich powder is fed through oxy-acetylene preheat flames into a low velocity oxygen stream where it burns and produces superheated liquid iron oxide. Wherever the powder-fed flame is directed against a casting, the metal surface is brought to kindling temperature, then oxidized and blown away by the oxygen stream.

The blowpipe nozzle has a large center hole through which the low velocity oxygen stream is discharged. Around the large hole is a ring of ten preheat flame ports. Compressed air at 6 psi carries the powder through a separate hose to the powder attachment mounted on the blowpipe, where it is discharged from a flat tube above the nozzle. Other equipment is the same as used with regular hand-cutting blowpipes.

Results UNEQUALED PER DOLLAR INVESTED

Attention, Foundrymen!

IN EVERY INDUSTRY, THERE ARE TIMES WHEN NEW CONCERNS ARE FORMED TO MAKE A PRODUCT WHICH THEY CLAIM IS AS GOOD OR BETTER THAN THAT PRODUCED BY LONG ESTABLISHED COMPANIES, AND OFFER IT AT A LOWER PRICE.

Every foundryman knows the proving ground of value is not price, but results.

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For more than thirty-three years, Famous Cornell Cupola Flux has been so thorough and dependable in cleansing molten iron that leading foundries from coast to coast and Canada, use it with every charge of iron to *keep casting rejects at the minimum*, cost of production down, and deliveries prompt.

Famous Cornell Cupola Flux not only purges molten iron of impurities but increases fluidity, reduces sulphur.

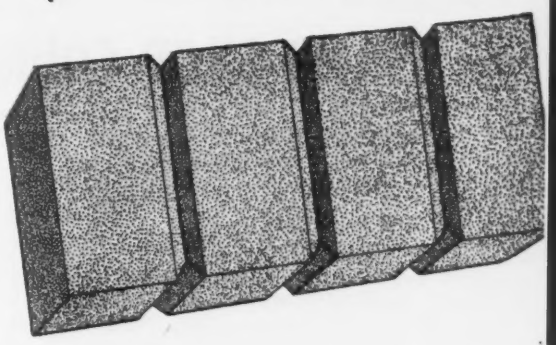
Improves cupola operation, too! Bridging over is practically eliminated, drops are cleaner, down time and maintenance cost are reduced amazingly.

SCORED BRICK FORM IS EASY TO USE. You simply lift Famous Cornell Cupola Flux out of container and toss it into cupola with each ton charge of iron, or break off one to three briquettes (quarter sections) for smaller charges, as per instructions.

WRITE FOR BULLETIN NO. 46-B

Famous **CORNELL CUPOLA FLUX**

THE METAL CLEANSER THAT GOES FARTHER IN THE PRODUCTION OF BETTER CASTINGS



EXCLUSIVE SCORED BRICK FORM uses less labor.

Famous **CORNELL BRASS FLUX**

CLEANSES MOLTEN BRASS even when dirtiest brass turnings or sweepings are used. You pour clean, strong castings which withstand high pressure tests and take a beautiful finish. The use of this flux saves you considerable tin and other metals, and keeps crucible and furnace linings cleaner, adds to lining

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Manufacturers of Iron, Semi-Steel, Malleable, Brass, Bronze Aluminum and Ladle Fluxes—Since 1918.

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Famous **CORNELL ALUMINUM FLUX**

CLEANSES MOLTEN ALUMINUM so that you pour clean, tough castings. No spongy or porous spots even when more scrap is used. Thinner yet stronger sections can be poured. Castings take a higher polish. Exclusive Formula greatly reduces obnoxious gases, improves working conditions. Dross contains no

(*Continued from page* 128)

cussed measurement of rate of growth of flake aggregate nodules, effect of temperature and composition on rate of growth, rate of nucleation of graphite nodules, effect of temperature on rate of nucleation and rate of gamma-range reaction. This was followed by a discussion of eutectoid reaction and subcritical graphitization of cementite.

In general, effects of alloying elements on rate of subcritical graphitization of cementite are qualitatively the same as on gamma-range graphitization reaction. Alloying elements such as chromium, copper and sulphur profoundly affect the rate at which cementite decomposes to form graphite, whether in the gamma range or at subcritical temperatures. Speaker traced effect of the more common alloying elements which may be found in cast irons. These effects are so important and often so surprising that a study of graphitization kinetics would hardly be complete without some speculation regarding their cause.

Program of the concluding gray iron session, presided over by Howard H. Wilder, Vanadium Corp. of America, Detroit, and J. L. Brooks, Muskegon Piston Ring Co., Sparta, Mich., comprised three papers. The first, presented by W. W. Austin Jr., Southern Research Institute, Birmingham, reviewed additional results of an investigation by the institute under sponsorship of Woodward Iron Co. to improve machinability of high-phosphorous gray iron.

Results of this work point to significant improvement in machinability through desulphurization followed by a zirconium-ferrosilicon addition. Tests indicate that the treatment will make tool life ratings of a 0.65 per cent P gray iron equivalent to an untreated 0.25 per cent P iron of normal sulphur content.

A progress report of the Gray Iron Division's Chill Test Committee was given by D. E. Krause, Gray Iron Research Institute, Columbus, O. Discussing the wedge test and the test in which a bar is cast against a chill, it was pointed out that the check on chill depth offers one of the cheapest and easiest tests adapted to use by the small foundry in maintaining quality uniformity. One recommendation was to quench the wedge gradually so as to avoid rapid cooling. A suggestion in subsequent discussion was to use a yellow insect-repellant lamp to aid reading the chill piece.

Concluding paper, by Ralph A. Clark, Electro Metallurgical Division, Detroit, described the beneficial results of a silicon-chromium alloy as an addition for the improvement of automotive cylinder blocks and other intricate gray iron castings. A detailed article on this subject by Mr. Clark will be presented in a coming issue of FOUNDRY.

The Gray Iron Division roundtable luncheon had a capacity attendance. A. O. Baroczak, Superior Foundry Inc., Cleveland, presided, assisted by Carl A. Harmon, Hanna Furnace Corp., Buffalo. General discussion theme concerned problems induced by material shortages and was presented by J. F. Dobbs, New York Air Brake Co., Watertown, N. Y.; A. J. MacDonald, Hanna Furnace Corp., and S. A. Kundrat, Homestead Valve Mfg. Co., Coraopolis, Pa.

SAND SHOP COURSE

FIRST of the three sessions of the Sand Shop Course, a regular feature of AFS conventions, was under chairmanship of F. S. Brewster, H. W. Dietert Co., Detroit. Discussion leader, Earl E. Woodliff, Foundry Sand Service Engineering Co., Detroit, in a talk entitled "Malleable Foundry Sand Control," reviewed his experiences in revamping method of sand control in a large malleable iron foundry. That experience and later at a floor type molding malleable foundry, furnished practical solutions to many sand control problems.

Mr. Woodliff pointed out that selection and control of the sand mixture in the malleable foundry is most exacting because finish requirements are those of bronze and metal temperatures are those of steel. He suggested selection of sand by specification rather than by name or number to effect better quality sand and superior surface finish. The speaker exhibited a chart of grain distribution and used it to point out what proportion of fine and coarse grains should be used for best results. Another chart showed clay and moisture content of various sands. Metal penetration into molds and cores is a serious problem, resulting directly from use of low density sand, and can be remedied by harder ramming and by broadening grain distribution. Addition of coarser sands is as beneficial as addition of fines.

Summarizing, Mr. Woodliff stated that often local sands can well be used at considerable saving if they are used under direction of a sand technician specially trained to select base sands and set up formulations to specific requirements. Type of clay used in molding sand bonding is important. Recent high temperature tests have shown that the range between which a binder is effective on the temperature scale is but slightly affected by amount of binders normally employed. Different binders have bonding ranges over different temperature ranges enabling selection of them to control hot strength or collapsibility of a core as desired. Sand control in the final analysis is binder selection.

In the discussion following the talk questions regarding shrinkage factors, dry strengths of molding sands, flowability, moisture, sticking of sand, hopper design, were answered.

Describe Shell Molding

A large interested audience attended the second sand shop course session Tuesday night. R. H. Olmsted, Whitehead Bros. Co., Cleveland, was chairman, and the speakers were Bernard N. Ames, New York Naval Shipyard, Brooklyn, and Warren C. Jeffery, University of Alabama, University, Ala. Mr. Ames presented a discussion of shell molding in which resin forms the binding agent for the sand. Various details relating to the practices employed are described in an article by Ames, Donner and Kahn published in the August, 1950 issue of FOUNDRY.

Mr. Jeffery spoke on use of resin binder for cores, and told how one southern foundry was enabled to increase considerably its core production by replacing the regularly used binder with resin without necessity of increasing core oven capacity. Increase in production essentially was due to the much shorter baking period required with resin.

Sand control in the steel foundry was the discussion topic at the concluding shop course session. R. H. Jacoby, Key Co., East St. Louis, Ill., presided, with H. W. Meyer, General Steel Castings Corp., Granite City, Ill., co-chairman. C. B. Schureman, Baroid Sales Division, National Lead Co., Chicago, was discussion leader.

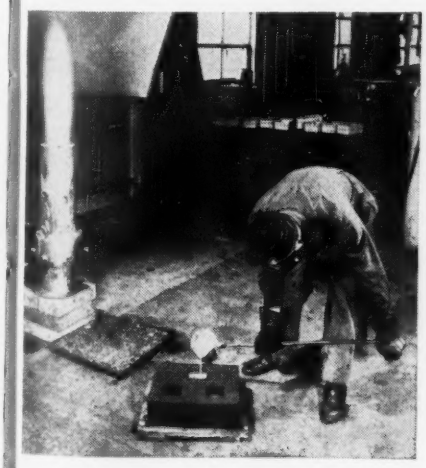
In considering the first subject, sand reclamation, it was brought out that to be successful, a sand reclamation system must eliminate the build-up of clay. Experiments have proved as the clay content increases, castings progressively get worse. Carbon build-up does not seem to progress beyond a certain point and in experimental work done under the auspices of the Steel Founders' Society of America, reclaimed sand seemed to

(*Continued on page* 133)

MEXICAN CORDIP®—ANOTHER NEW PRODUCT DEVELOPED BY THE UNITED STATES GRAPHITE COMPANY

NEW NON-FERMENTING WASH GIVES SMOOTHER, TRUER CASTINGS

Mexican Cordip is just one of the many new products that are continually being developed by the research facilities of The United States Graphite Company. Mexican Cordip is a high temperature coating that gives castings maximum surface smoothness. Dry or green cores maintain true dimensions because Mexican Cordip *will not build up or run on core surfaces.* It penetrates sand to an effective depth to prevent burn-in. Since its development in the laboratories, Mexican Cordip has proven its worth in daily use in some of America's finest foundries. Mexican Cordip is supplied in powdered form complete with binder and is *easy to prepare and use* either as a spray or dip. Also, Mexican Cordip is non-fermenting. There's no messy dip tank cleaning . . . no disagreeable odors.



Small cupola used to simulate actual pouring conditions at The United States Graphite Company laboratory.

1⅛" cores with small cylindrical cavity being charged with metal (left) for insertion into the hot zone of the Dilatometer (right). Metal melts to form a small pellet. After cooling, the core and casting are studied for ease of removal, coating remaining, burn-in, and surface appearance.

MODERN LABORATORY DUPLICATES ACTUAL FOUNDRY CONDITIONS FOR BETTER PRODUCT RESEARCH

Old-time foundry men and newly graduated metallurgists alike who have visited The United States Graphite Company's neat, new foundry research laboratories in Saginaw have been enthusiastic about the completeness of the equipment, *the thoroughness of the tests*—and the extent to which the engineers here are going in order to develop even better Mexican Graphite products for America's foundries.

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There is a core oven and complete sand testing equipment so that precise studies can be made of the penetration, effect on surface, and physical characteristic of sand when using various types of Mexican Graphite washes.

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154-A

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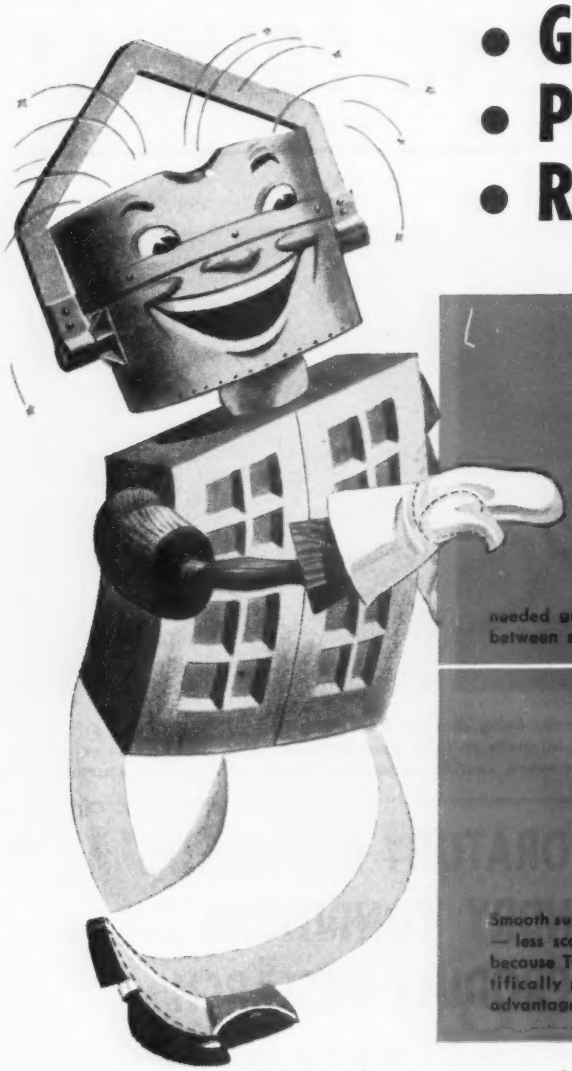

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MORE GREEN STRENGTH: In both green and dry core stages there is greater binding strength with Truscor and Amerikor — they supply the needed green bond and strong affinity between sand granules.

FINE FLOWABILITY AND TEXTURE: The uniform quality of Truscor and Amerikor insures quicker mix — easier blending — less sticking — uniform ramming — increased permeability.

FINER DETAIL: Smooth surfaces—sharp, unbroken edges — less scabbing, cold shut, buckling — because Truscor and Amerikor are scientifically processed to provide these advantages.

EASY, BURN-OUT COLLAPSIBILITY: Because cereal binder burns out rapidly and completely during casting, you are sure of ready collapsibility and easy shake out when you use Truscor or Amerikor.

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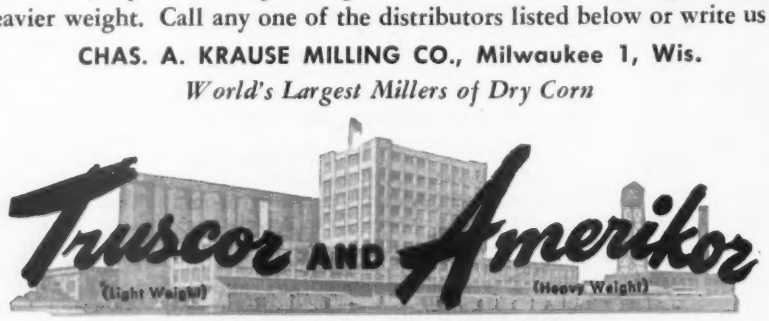

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(*Continued from page* 130)

do a better job than new sand. It was the opinion of the researchers that perhaps the carbon coating on the sand grains provides a better bonding surface than that furnished by new silica grains. It was also cited that room temperature sand properties are of little value in forecasting high temperature properties in sand which would be suitable for castings, but when a sand mixture has been found which is satisfactory, the room temperature properties then can be used advantageously as standards in maintaining the required properties in the molding sand.

Some of the beneficial properties of cellulose material in molding and core sand were listed as: Helps to produce a reducing atmosphere; provides a stable sand and a better finish, permits harder ramming; reduces veining.

Underbaked, underoxidized oil bonded cores, it was claimed ,are the cause, of some of the industry's worst problems. Mr. Schureman emphasized the need for correct baking of cores and their prompt use to prevent moisture pickup and deterioration.

Favors Solid Cores

Mr. Schureman pointed out in response to a question—which is better practice, use of solid highly collapsible cores or less collapsible hollowed out cores—that it seemed self evident there is no need for hollowing out the core unless it is for ease of handling. A solid, properly made core not only is more satisfactory but also is much cheaper to produce.

Another question—what properties are required in a sand mixture to resist flow of metal yet peel cleanly and at the same time collapse sufficiently fast to prevent tearing in castings of medium and heavy sections—brought these suggestions: Properties necessary are high green strength obtained with a combination of clay and bentonite plus dextrine and wood flour to get toughness. For clean removal of the sand from the casting, ramming uniformly hard throughout the mold is important. Also needed are good hot strength in the 1100° F range, wide sand grain distribution, and plasticity at high temperature to prevent veining. Mr. Schureman suggested the use of bentonite and clay in the proportion of 60:40. Also, with heavy sections, a wash must be properly applied to the mold face.

Considerable interest was evidenced in the question how to stop penetration. Mr. Schureman pointed out that these factors help to prevent penetration: Spread the grain distribution wide; ram; use a combination of 60 per cent bentonite and 40 per cent clay, dextrine or cereal; dry the mold for a long time at elevated temperature, probably the most important factor between penetration and no penetration; set the cores, close the mold and pour immediately.

BRASS, BRONZE SAND COURSE.....

TWO evening sessions devoted to sand control for copper-base alloys were sponsored by the Brass and Bronze Division. Discussion at both was led by Harry W. Dietert, Harry W. Dietert Co., Detroit. The first session, limited to structural, green, air set and dry properties of sand, had Walter W. Edens, Badger Brass & Aluminum Foundry Co., Milwaukee, as chairman.

In considering structural properties, Mr. Dietert suggested a sand having fines of 3 to 50 microns, that is under 200 mesh sieve, held to within 15 per cent for brass and bronze castings. When fines approach 20 per cent, the sand is too sensitive. He suggested a density of 95 to 102 pounds, which provides a light sand. These specifications could be applied to both naturally bonded and synthetic sands. It has been found total quantity of fines should be held down to a low limit to control surface defects.

Mr. Dietert believes more foundrymen will find it advisable to include a sand preparation department in their operations to remove excess fines and add bentonite to adjust the bond. To test the number of fines correctly, Mr. Dietert suggested the use of a hydrometer with an AFS standardized index.

Permeability controls the venting of the mold and should be maximum consistent with finish desired. For green properties of the sand, he suggested a hardness of 70 to 80 and a green compression of 7½ to 10 psi. Having established these specifications, only enough moisture should be added to the sand to obtain a deformation of 0.016 to 0.020. Where increased bond is necessary, Mr. Dietert recommended southern and western bentonite in 50:50 proportions.

In conclusion Mr. Dietert emphasized that molding sand should be purchased primarily for its structural properties, adjusting the bond in the foundry to meet production requirements. He also stressed that values be determined for green strength and green deformation and the use of only enough water to bring green deformation into the desired range.

At the second and concluding brass and bronze sand course, Mr. Dietert discussed hot and retained properties of sand. Stating that load carrying powers of sand are important factors, Mr. Dietert described sand mixtures having good load carrying properties. These included the fire clay, and fire clay and bentonite mixtures. He dwelt on some of the properties which may be determined through testing, including air set strength, dry sand strength, hot compression strength, and retained compression strength.

He associated some of the casting defects that may be developed with sands having strength values either above or below those considered optimum. Thus, he showed the need for compromising various properties to achieve a balanced sand that will produce sound castings.

PATTERNMAKING.....

CONSIDERABLE interest was shown by the large group in attendance at the technical session sponsored by the Pattern Division. Harry Lees, Whitin Machine Co., Whitinsville, Mass., presided. Elmer Blake, Osborn Mfg. Co., Cleveland, gave the first paper, entitled "Design of Coreboxes and Driers for Core Blowing." This paper was presented in detail in June FOUNDRY, starting on page 114.

Mr. Blake stated that experience has indicated these fundamentals are required in core blowing: A sufficient supply of dry air through a line of ample capacity at a pressure in general not less than 80 psi; properly prepared sand with controlled moisture; machine clamps both vertical and horizontal sufficient to clamp the box tightly during the blow cycle; a sand reservoir of suitable size for core being blown—large reservoirs for small cores not practical; blow plate drilled with holes of proper size matching accurately those in the corebox; corebox should be machined parallel top and bottom and if clamped from the side, sides should be parallel; joint fitted accurately to prevent leakage of sand; guide rails and end stop so the holes in the box will line

(*Continued on page* 135)

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(*Continued from page* 133)

up with the holes in the blowplate each time the box is placed in the machine; blow holes drilled and spaced so sand will pack uniformly from the bottom up; air release vents inserted to divert sand to pockets and corners or around bosses. Vents in the lower part of the box are necessary but they lose their efficiency when covered with sand so more vents are required in the upper half of the box.

F. J. Oklessen, Motor Pattern Co., Cleveland, presented the session's second paper, entitled "Design of Core Setting and Rubbing Fixtures." Mr. Oklessen pointed out that perfect pattern equipment is not enough, that in high production work fixtures are necessary to check core sizes and shapes, others to hold cores for grinding and finally fixtures to locate the cores properly in the mold. He then used slides to show the equipment.

Gages Support Core

Core rubbing gages may be made of wood, aluminum or cast iron and should be built to support the core so that any strain caused by grinding either by machine or by hand is relieved. Second consideration is to hold the core firmly, yet with sufficient clearance to allow the operator to set and remove it without scoring. Mr. Oklessen pointed to the advisability of keeping the side rails below the face of the wheel, the clearance being a standard amount—0.750-in., for example, so that a ¾-in. steel bar on the top could be used as a guide in adjusting the grinding wheel to the correct height.

A jacket assembly fixture is important since it consists of a base to receive the cores, allowing chaplet seats to be rubbed while they are in place and then bolting them together for drying. Another fixture is provided for checking the assembly. The assembled cores are set in on edge and the top of the fixture closed down. The check is made rapidly since when all the pins and slides in the fixture are flush with the tops of the bosses, the cores are in proper location and the assembly is perfect.

The speaker then cited the advantages of a core assembly fixture for positioning several cores for one mold. A pickup fixture then transfers the entire assembly to the drag half of the mold. He also advised the use of a mold depth gage occasionally since the strike-off bar wears down in the center and a crown of sand may be at the bottom of the mold which ultimately is responsible for the false setting of cores.

Mr. Oklessen also showed a water test fixture made from the base of an obsolete molding machine. Stoppers for the mold openings must be provided, a water inlet with an air line to provide a pressure reading, also a drain to dispose of the liquid after testing. In the fixture illustrated, the head of the molding machine was welded secure in the forward position. The squeeze piston raises the casting against the head and seals off the top and bottom openings, and regulator valves are on the head of the machine.

The speaker recommended hard chrome plating of those surfaces subject to contact with foundry or core sand since the wear obtained from 0.010 chrome plating is equal to that of ¼-in. cold-rolled steel. On fixtures where a part moves back and forth, the bushings bars or guides should be plated and ground to size. Also, never oil such guides since sand will stick to them and gum up the ways. If the chrome starts to wear through on any part, all old chrome should be removed and a new layer added.

In conclusion, Mr. Oklessen suggested that in setting up new jobs, time and thought should be given to including gage and fixture costs for the equipment being ordered since these items will help a foundry produce the best possible castings with the least amount of returnable scrap caused by off-dimensions, cracks or shifts.

The pattern roundtable luncheon with L. F. Tucker, City Pattern & Foundry Co., South Bend, Ind., presiding, featured a discussion of "Pattern Shop Machinery and Equipment." Discussion leader was William Dashiell, Kindt-Collins Co., Cleveland. He described some of the newer pattern products and equipment, outlining, briefly, salient characteristics of each.

Most of the discussion among those present centered around a new type of planer said to possess great accuracy and speed, and the necessity for having a wood turning lathe specially designed for pattern work. Products invoking the greatest interest were plastic fillets; accurate, wear-resistant dowel pins, and patterns and coreboxes made from a heat treated copper-silicon bronze alloy said to possess exceptionally good wear resistance.

BRASS and BRONZE CASTINGS.....

ACTIVITIES of the Brass and Bronze Division were concentrated on the first three days of the convention and consisted of three technical sesions, the annual roundtable luncheon and business meeting, and a two-period sand course. Exceptionally good attendance featured all these events.

The series opened with a technical session at which W. B. Scott, National Bearing Division, American Brake Shoe Co., Meadville, Pa., presided and H. G. Schwab, Bunting Brass & Bronze Co., Toledo, O., was co-chairman. Three papers were presented.

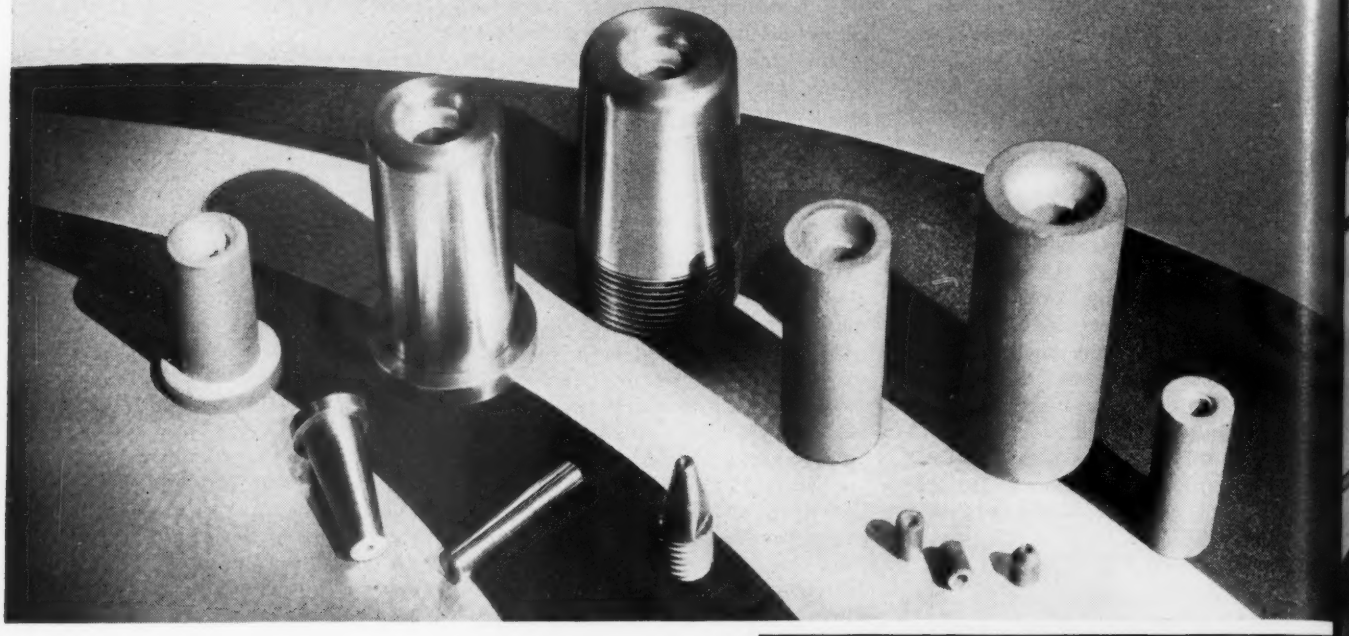
A. H. Hesse, metallurgical engineer, R. Lavin & Sons Inc., Chicago, reviewed a paper on "Refining Secondary Copper Alloys" in the preparation of which he had collaborated with Marvin Glassenberg and L. F. Mondolfo, graduate student and associate professor of metallurgical engineering, respectively, Illinois Institute of Technology, Chicago. Objectives of experiments described were (1) to determine rates of removal of common impurities from secondary alloys by means of air injection, and (2) to investigate effect of commercial oxygen on these rates of removal. Substitution of oxygen for air for more rapid refining is theoretically sound, since faster oxidiation of impurities should be achieved.

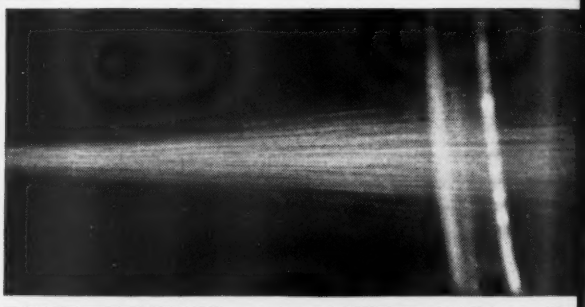
Sequence of removal of the elements by oxidation was found to be: Aluminum, manganese, silicon, phosphorus, iron and zinc. However, although the removal rate for each element may be different, all are being removed simultaneously. Use of pure oxygen in place of air showed little value in refining the typical brass alloy, Mr. Hesse reported, but indications are that oxygen use can result in efficient removal of iron where high zinc concentrations are present. Further investigation is required before conclusive evidence on value of oxygen use can be determined.

"Radiography as an Assistant to Foundry Practice," a paper prepared by S. A. Brosky, Pittsburgh Testing Laboratory, and C. B. Johnson, Rockwell Mfg. Co., Pittsburgh, was presented by the former. By way of introduction, it was pointed out that nonferrous castings were at all-time low in acceptance in 1944. There was little inspection and sometimes rejections were 100 per cent. Frequently valve bodies leaked after the skin was removed in machining. Use of virgin metal increased the yield, but this did not provide the answer

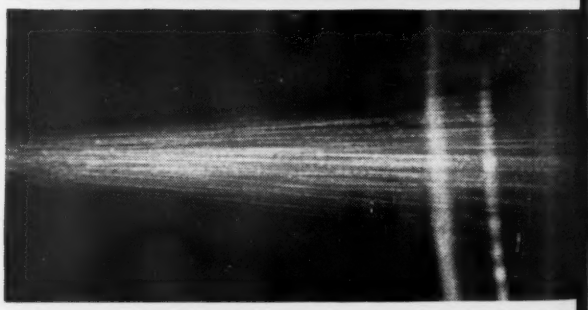
(*Continued on page* 138)

You Can Increase Nozzle Life

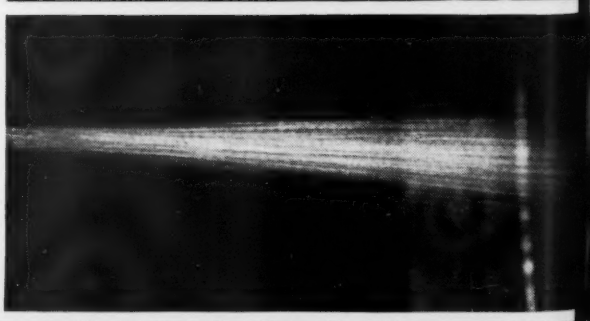




High speed photograph of stream from new iron nozzle — note that stream concentration and abrasive velocity and volume are fair.



Stream from the same nozzle after three hours with silica sand. Outlet opening worn to twice original size — stream concentration poor, abrasive velocity and volume low.



Stream from Norbide Nozzle after 404 hours with sand — outlet diameter worn only 0.032"—hundreds of hours of useful life remain—marked stream concentration—high abrasive velocity and volume.

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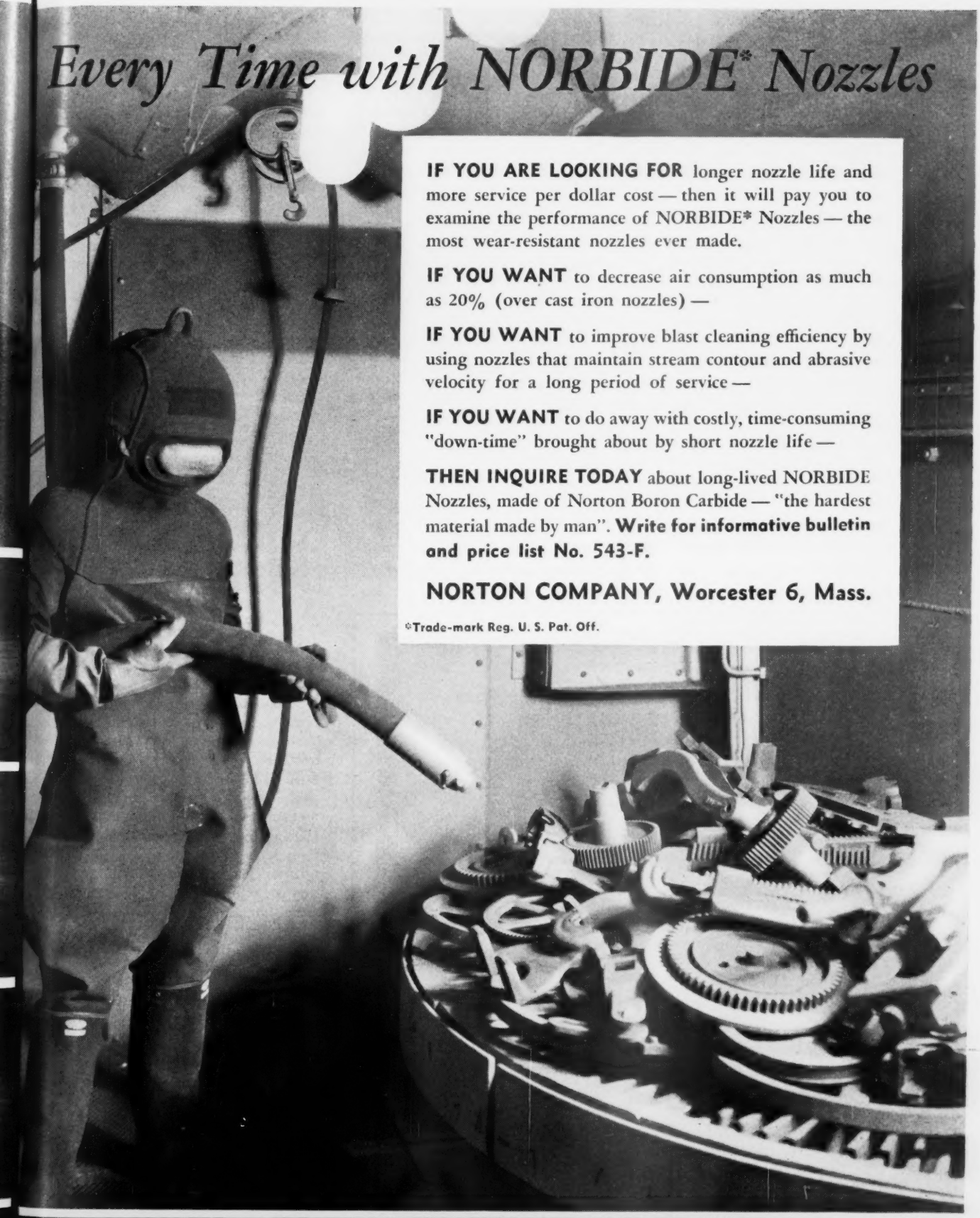

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(*Continued from page* 135)
to the problem because good castings also could be made with secondary metal.

Radiography, according to Mr. Brosky, seemed to offer the best procedure to attack the problem. Slicing of castings in connection with this soon indicated that structure was involved. Since x-raying a whole valve body was too costly, a specific area was checked. It was found that such a spot check of an area about 2 x 2 inches usually would show if a casting would leak. When a casting is larger than 4 x 4 inches, making two spot checks proves adequate. A mottled effect in the radiograph is indicative of leakage; uniform grain is not.

Mr. Brosky pointed out the foundries objected to the inspection method at first, but now heartily approve it. Foundry losses now are 2 per cent or less and the practice has been extended to include Monel, nickel and other metals.

This paper raised the question as to why, as the speaker had mentioned, better castings were obtained with virgin metal versus secondary. Mr. Brosky replied that in the beginning it was believed virgin was requisite. Shortage of virgin metal, however, forced use of secondary and it was found that the latter produced good castings although virgin had a slight edge. H. J. Roast, consultant, Westmount, Que., mentioned that virgin metal is harder to melt and keep free from contamination, as compared with secondary. Co-author Johnson explained that practice is to purge the metal with chemically pure nitrogen for 6 to 8 minutes in the furnace and then about 3 minutes in the ladle.

In the final paper of the session, "Riser Efficiency Increased by Insulation," James O'Keeffe Jr., Exomet Inc., Conneaut, O., discussed riser effect and pointed out that keeping metal in the riser molten for a longer period will improve casting quality. Risering is simple, but application to specific castings may be difficult.

Position the riser properly in the mold, Mr. O'Keeffe suggested. Use of chills is desirable. The riser must not be frozen off. Insulation gives higher yield in riser feeding, thus permits smaller risers. And, of course, smaller risers decrease riser remelt.

The brass and bronze roundtable luncheon was a virtual sellout. Advance preparations had been made for 95, attendance was 210. B. A. Miller, Eddystone Division, Baldwin-Lima-Hamilton Corp., Philadelphia, presided and H. L. Smith, Federated Metals Division, American Smelting & Refining Co., Pittsburgh, was co-chairman. This event was well organized in advance. A chairman for each table polled his group to determine which one of 16 mimeographed questions on foundry practice should be submitted for open discussion. Tables were called upon at random and so active did discussion become that only five topics were disposed of.

Included in discussion topics were: Comparative quality of metal melted in various types of furnaces; relative merits of melting under oxidizing or reducing atmosphere; synthetic versus natural bonded sand; success in use of insulated risers for high-shrinkage alloys; and test bars as a determination of casting quality.

VISITATION: Hamilton Foundry & Machine Co., Hamilton, O., on Apr. 19 was one of 21 firms co-operating with public and parochial schools of Hamilton and Butler Counties and the Hamilton Chamber of Commerce in conducting a business-industry-education day. Forty-four local teachers visited the foundry. At top, Peter E. Rentschler, company president, is shown addressing the visitors. Bottom view shows V. L. Diefenbacher acting as guide for the teachers on a tour of the plant

Hold Business Meeting

At the conclusion of the roundtable, the business meeting of the Brass and Bronze Division was convened by its chairman, George P. Halliwell, director of research, H. Kramer & Co., Chicago. Reports of standing committees were made and discussed, after which new officers were elected as follows: Chairman, A. K. Higgins, metallurgist, Allis-Chalmers Mfg. Co., Milwaukee; vice chairman and chairman of the Program and Papers Committee, B. N. Ames, senior metallurgist, New York Naval Shipyard, Brooklyn, N. Y.; and vice chairman, Program and Papers Committee, W. B. Scott, National Bearing Division, American Brake Shoe Co., Meadville, Pa.

Two papers provided the program for the second brass and bronze session at which B. N. Ames, senior metallurgist, New York Naval Shipyard, Brooklyn, N. Y., presided jointly with John W. Bolton, metallurgist, Lunkenheimer Co., Cincinnati.

In the first paper, Clyde L. Frear, senior materials engineer, Bureau of Ships, Navy Department, Washington, discussed the "U. S. Navy Nonferrous Development Program." The speaker pointed out that from 3 to 5 per cent of the metal in a ship is in the form of castings and that the service requirements are rugged. Most of the nonferrous castings are tin bronzes, due to corrosion resistance.

(*Continued on page* 141)

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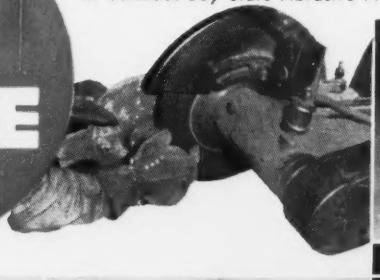
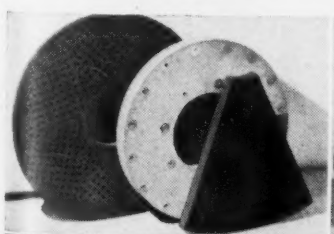


SNAGGING WHEELS

MOUNTED POINTS



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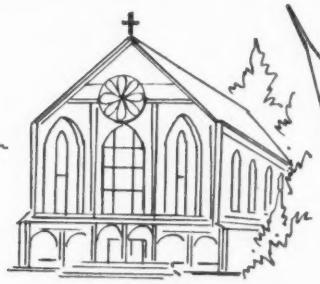

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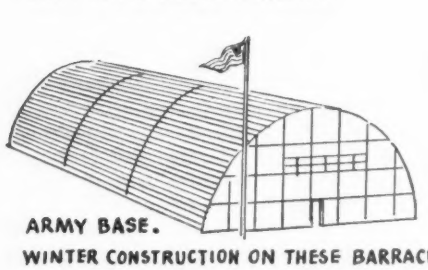

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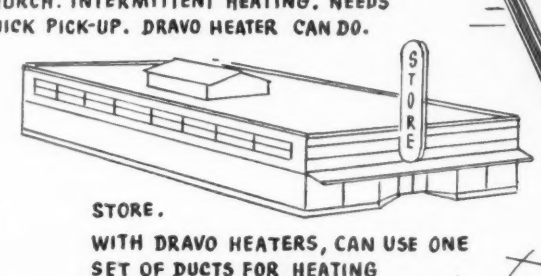
WINTER CONSTRUCTION ON THESE BARRACKS. CAN INSTALL DRAVO HEATERS EARLY FOR HEAT DURING CONSTRUCTION AND AFTER COMPLETION.



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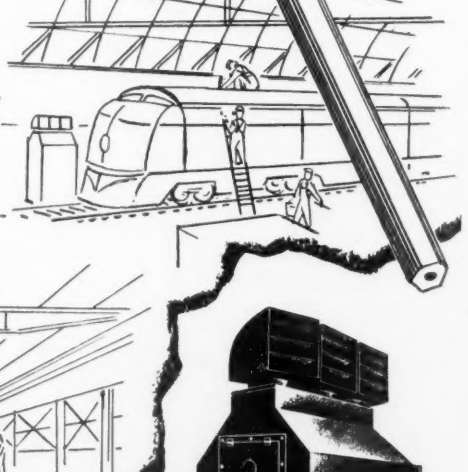

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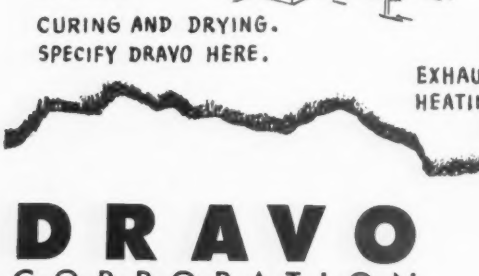

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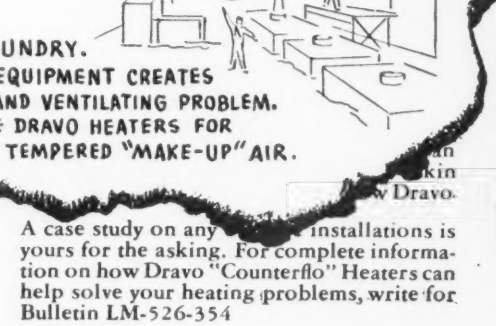

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(*Continued from page* 138)

Most of the trouble encountered involves leakage arising from dendritic shrinkage in making these castings.

Research projects under way are concerned with this dendritic shrinkage, convectional currents or directional solidification, melting practices and radiography for inspection. Needed badly, Mr. Frear emphasized, are standards for radiography.

Among other needs enumerated are a procedure for knowing temperatures in the furnace and during pouring, a means to determine melt quality, insulating sleeves such as can be taken off the shelf, and molding material which does not contain hydrogen.

Use Tin To Prevent Corrosion

During discussion, someone suggested use of plaster molds and pointed out these are suitable for making castings weighing up to several hundred pounds. Mr. Frear stated the Navy has not used such molds. There was an inquiry as to whether the Navy is using as a guide to melt quality the fracture test developed in the Brass and Bronze research program. It was revealed that this test is being used at the New York Navy Yard, but not for a sufficient length of time to evaluate its usefulness. A question was raised as to substitution of manganese bronzes by aluminum bronzes. Mr. Frear emphasized that the Navy finds it must have bronzes containing at least 5 per cent tin, otherwise they will not withstand corrosion.

"Melt Quality and Fracture Characteristics of 85-5-5-5 Red Brass and 88-8-4 Bronze," second paper at this session, constituted the third progress report on a research project sponsored by the research committee of the Brass and Bronze Division. The report was prepared by R. D. Shelleng, research fellow, C. Upthegrove, professor, department of metallurgical engineering, and F. B. Rote, associate professor, department of metallurgical engineering and metal processing, University of Michigan, Ann Arbor, Mich. Mr. Shelleng presented the first part and Prof. Rote the second.

Purpose of the project is to develop a fracture test for evaluating melt quality of brass and bronze alloys. The third progress report presented data on effects of variations in size and shape of the chill block casting and variations in the temperature of the chiller from room temperature to 700° F on fracture appearance of 85-5-5-5 alloy chill blocks.

These conclusions were reported: 1. The ¾ x 3 x 6-in. chilled block appears to be the most satisfactory of sizes investigated for foundry quality control. 2. There is no effect on the fracture appearance of varying the chiller temperature from room temperature to 700° F. 3. A definite correlation has been found between melt quality of 88-8-4 alloy and fracture appearance of chilled blocks. A high-quality fracture is characterized by a fine, dense texture and a light yellow color. A low-quality fracture is reddish-tan or gray-tan and has a coarse texture. 4. Heats degassed with dried nitrogen show an improvement in fracture characteristics, accompanying improvement in melt quality.

The authors emphasized that men using the test should be trained to evaluate the fractures because color changes are rather difficult for the untrained eye to see. To facilitate examination good lighting is essential. A blue fluorescent light has been found fairly satisfactory for this purpose. The authors displayed a special light box H. W. Dietert Co., Detroit, has developed to facilitate fracture examination.

Third and concluding brass and bronze session featured two papers. F. L. Riddell, H. Kramer & Co., Chicago, presided, and H. G. Schwab, Bunting Brass & Bronze Co., Toledo, was co-chairman. First paper was "Effects of Certain Elements on Grain Size of Cast Copper-Base Alloys," authored by R. A. Colton and M. Margolis, research department, American Smelting and Refining Co., Barber, N. J., and presented by the former.

It was pointed out that improved performance of copper-base casting alloys can come about only with better understanding of factors controlling physical properties, casting behavior, machinability and other characteristics of engineering importance. Among the least understood of these factors is the role of grain size in determining alloy behavior. Because correlated data on the relationship of grain size and properties are not available, the authors experimented to determine effect of nickel on grain size of copper plus 5 per cent lead, copper plus 5 per cent tin, copper plus 5 per cent zinc and high-purity 85-5-5-5 alloy. By eliminating cooling rate as a variable it was possible to measure effects of nickel content up to 2 per cent on grain size of castings cooled at a rate of 35° F per minute. From these experiments, Mr. Colton said it was possible to draw these conclusions:

1. Composition of copper-base alloys influences grain size but the effect is far less significant than cooling rate. A high cooling rate apparently is the best method for obtaining fine grain in a cast alloy.

2. Grain of copper is refined markedly by 5 per cent lead. Lower lead contents may contribute to grain re-

WINNERS: For the second time in four years, apprentices at Caterpillar Tractor Co., Peoria, Ill., have taken two first prizes in the annual apprentice contest sponsored by American Foundrymen's Society. Left to right, are: Marvin L. Lohnes, first prize winner, metal patternmaking; Robert Selburg, patternmaking instructor at Caterpillar; Burt L. Bevis, Caterpillar foundry training supervisor, and Harold Carty, first prize winner, gray iron casting. Since 1935, company apprentices have won nine firsts, two seconds, and two thirds. Photos by Caterpillar Tractor Co.

finement of commercial copper-base casting alloys.

3. Nickel up to 2 per cent in a 5 per cent Pb-Cu alloy has negligible effect on grain size.

4. Tin of 5 per cent refines grain of copper but less than does lead.

5. Nickel up to 0.10 per cent has some grain refining effect on Cu-5 per cent Sn alloys. Higher nickel contents seem to have no further effects.

6. Zinc of 5 per cent has negligible effect on grain size of copper.

7. Nickel up to 2 per cent has no measurable effects on grain size of Cu-5 per cent Zn alloys.

8. Nickel up to 0.10 per cent refines grain of a high-purity 85-5-5-5 alloy slightly, but the effect disappears and some coarsening occurs with higher nickel content.

9. With a fast cooling rate (chill casting) high purity 85-5-5-5 alloy with 0.50 per cent nickel has very slightly finer grain size than does the same alloy without nickel.

10. Nickel up to 2 per cent has no observable influence on shrinkage characteristics of any of the alloys studied with both slow and fast cooling rates.

11. Nickel up to 2 per cent has no measurable effect on distribution and size of lead constituent in a 5 per cent Pb-Cu alloy.

12. From a cooling rate curve at 35 degrees per minute high-purity 85-5-5-5 alloy begins to freeze at 1835° F.

Concluding paper of the session was a description of the manufacture of bronze boiler drop plugs. The paper was prepared by B. F. Kline, chief chemist, and J. R. Davidson, supervisor of foundry operations, Southern Pacific Railroad, Sacramento, Calif. Drop plugs, used in steam locomotives to serve as a warning of low water which might cause a boiler explosion, are subjected to unusually severe service, and extreme care is exercised in their production and testing. No scrap returns are used in the melt except copper; it has been found that heavy scrap trolley copper performs better than new ingot—the oxide film on the trolley metal counteracts a tendency to absorb oxygen.

EDUCATIONAL ACTIVITIES.....

THE foundry industry has done a poor job of selling itself to the high school and trade school students. This charge was made by Roy W. Schroeder, assistant professor, foundry and pattern laboratory, Navy Pier Branch, University of Illinois, Chicago, at the first of two convention sessions sponsored by the Educational Division.

The speaker stated that, in the past, the schools have not known exactly what foundries wanted in the way of teaching programs. Only by active co-operation between school and industry can a curriculum be set up that will reflect the desires of the shops involved. To the fundamentals required for trade training, it is necessary to add that which will give a working knowledge of machine production. This calls for molding machines and necessary auxiliary equipment. Until industry shows real interest in foundry training in the high and trade schools, the necessary space, equipment and teachers will not be made available.

An outstanding example of co-operative effort, it was stated, is the model foundry at Hackley Manual Training School, Muskegon, Mich. (FOUNDRY, March 1949), a project sparked by Michigan foundrymen under the leadership of George W. Cannon, former chairman, Campbell, Wyant & Cannon Foundry Co. Mr. Schroeder also paid tribute to vocational education work in Milwaukee and the program recently instituted at Tennessee Agricultural and Industrial College. The speaker said that industry has overlooked a potential reserve of manpower in not bringing the history and romance of the foundry industry to young people while they are still in the state of flux. Movies, shop trips, lectures to the pupils in the 7th, 8th and 9th grades and to the PTA's will do a great deal in breaking down the self-imposed barrier raised by the foundry industry through lack of good housekeeping.

Concluding paper at this session was a description of the two-year training period given by American Brake Shoe Co. to young men the company recruits, largely from engineering schools. This was presented by T. W. Russell Jr., of that company.

Under the Brake Shoe program, the trainee works for a specified period in various departments, for a time under the guidance of a skilled operator and the remainder of the time on his own. The program is varied according to whether the individual is intended for work in sales, production, metallurgy, accounting, etc. However, the course is flexible so that it is possible to transfer men from departments for which they originally were intended to others in which they appear to be better suited. The plant superintendent is responsible for the training progress.

Chairman of this session was William H. Ruten, Polytechnical Institute of Brooklyn, New York, with Prof. George J. Barker, University of Wisconsin, co-chairman. Professor Barker, chairman of the AFS Educational Division, also presided at the dinner session of this group, assisted by George K. Dreher, Foundry Educational Foundation, Cleveland.

The best way to break in the college graduate who joins the foundry is to give him tests and assignments which will challenge his mind and his resources, it was stated by Dean Clement J. Freund, University of Detroit, first speaker at the dinner session. One good way not to train the young man is to give him a shovel, show him a pile of sand and forget about him, the speaker stated. It was suggested that foundries establish for their college graduates a formal, supervised course, like the two-year college apprenticeship which has been so successful in such organizations as Westinghouse Electric Corp., the Falk Corp., General Electric Co., etc.

Dean Freund emphasized that the college graduate knows something about science and engineering, but he is not a foundryman, which emphasizes the importance of the training he receives when he enters industry. It was pointed out, however, that an elaborate training organization is not necessary, and that a work plan for two or three young men is relatively simple to develop.

Foundry Training Lags

The speaker said that those foundries which introduce young engineers into their plants will thereby have a hand in promoting the technological advancement of the foundry industry. "The chemical, electrical, utility, automobile, radio, aircraft and other industries have accomplished wonders by smart recruiting and orientation of engineering college graduates. There is not a single reason that I can think of why the foundrymen of the United States should not do at least as well," he concluded.

Suggestions for absorbing the technical trainee in industry were offered by Collins L. Carter, president, Albion Malleable Iron Co., Albion, Mich. Prefacing his remarks with the statement that a foundry cannot afford to be without a trainee program, Mr. Carter pointed out that, on the average, a foundry has one management head for each 15 em-

(Continued on page 144)

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(*Continued from page* 142)

ployees. A plant with a total of 600 employees and 40 management men should require six to seven trainees per year to replace normal losses in the management ranks. Both engineering graduates and men from the company's own ranks provide the sources for these trainees and future management personnel.

Describing various programs currently employed by foundries in training new men, Mr. Carter emphasized that the trainee should learn how to get along with fellow employees. At the same time, management should take an active interest in the training program, encouraging those who make progress and giving added attention to those who are lagging. Mr. Carter urged that foundry management be realistic in anticipating losses in key personnel by promoting a continuing training program which will permit replacement of these losses.

TIME STUDY and METHODS.....

A timestudy and methods session sponsored by the AFS Timestudy and Methods Committee devoted its attention to a report which was an interpretation of data on fatigue factor values used by the foundry industry in its production operations. The report, embracing several special methods of determining fatigue allowances, was prepared and presented by M. E. Annich, superintendent of standards, American Brake Shoe Co., Mahwah, N. J. Chairman of the session was M. T. Sell, Sterling Foundry Co., Wellington, O., and H. R. Williams, Williams Management Engineers, Milwaukee, was co-chairman.

The special methods were reported to the committee in answer to a questionnaire circulated among AFS members in 1949. At the Cleveland convention in 1950 the committee presented Report No. 1 which constituted an attempt to summarize and present fatigue values used in plants of reporting members in which fatigue is applied on an overall rather than an elemental basis. In the present report, designated as No. 2, it was pointed out that many time study people are averse to using fatigue allowances on an overall basis because it is impossible to get the accuracy of values between jobs that can be obtained by using an elemental method. Moreover, the elemental method lends itself more readily and more logically to any changes in the fatigue allowance that may be made necessary through a change of practice in a job. The report states that it is sometimes desirable to use a compromise method.

FOUNDRY COSTS.....

WIDER use of specification sheets to effect profitable foundry operation was urged by John Taylor, vice president, Lester B. Knight & Associates Inc., Chicago, in his paper, "Spec" Sheets and Their Various Uses," at the foundry cost session. R. L. Lee, Grede Foundries Inc., Milwaukee, presided, and George Tisdale, Zenith Foundry Co., Milwaukee, was co-chairman

Although some foundries have realized value of specification sheets or cards and use them to good advantage, there is still a large percentage that have no records on how particular castings are made. Specification sheets can and should be used, particularly on molding and coremaking operations because it is in this type of work where the greatest losses occur through lack of proper information. With details of flask size, type of molding machine used or floor used, whether or not facing sand was used, etc., it is easier to justify a cost than it is with an approximate estimate.

Simplest form of specification can be kept on a card indexed according to customer and/or pattern number with a rough sketch of casting, showing position of gates, runners, risers and corresponding sizes. Other important details should be recorded adjacent to sketch and all information must be determined before a job is run.

In recent years specification data have been combined with standard data used for establishment of time values, supplying the foreman with specific data on how the job was done previously and also distinct elements of operation for which time has been allowed. The "spec" sheet is also important in labor relation programs, in settling all arguments as to whether or not an operator has been given an allowance to perform certain elements. For estimating purposes it is invaluable. Given information from supervisors as to molding and coremaking details, an inexperienced estimator can arrive at a final accurate price. Actual methods employed can be checked with original estimates and corrections made if there are any great differences. The "spec" sheet also can supply management with details concerning change in job costs if a particular change is to be made, without necessity of an experimental run or going into the shop to talk it over with foreman or superintendent.

Clyde E. McQuiston, Ohio State University, co-author with A. W. Schneble Jr., Advance Foundry Co., Dayton, O., presented their paper, "A New Method of Evaluating Costs in Jobbing Foundries." It was felt that certain inadequacies exist in the common method of foundry costing, wherein individual jobs are figured by dividing costs of mold and core departments by number of productive molding and coremaking hours for the same period. Some castings require more floor space during production than others while employing the same amount of productive labor. This places a serious limitation on productive capacity because it is not possible to increase labor in proportion to increased space required. It is impossible to define total capacity of foundry sales, cost and profit relationships, except by using average productive labor data.

Includes Many Items

The new method recognizes that each job has three distinctive characteristics: Evaluated average floor space required; ratio of mold and core direct labor hours for the job; and average number of daily molders. By these the job is defined. Cost breakdown should be by the mold, core, clean and ship, and melt departments on items directly chargeable to these departments. Overhead and general expense items are compiled on basis of combined departmental costs, excluding the melt department. Costs are also separated as rates, fixed and semi-fixed costs, the latter determined at various levels expressed in terms of men.

Mr. McQuiston explained method of determining actual costs in various departments and illustrated by slides comparison of results of the new and old costing methods. In summary the speaker stated by use of the new method competitive jobbing foundries can stabilize foundry operations at all times. When operating under high business activity conditions they are in position to choose jobs proving a good profit, chosen from ease of manufacture, delivery date, etc.

Interesting discussion which followed the talk indicated it was felt

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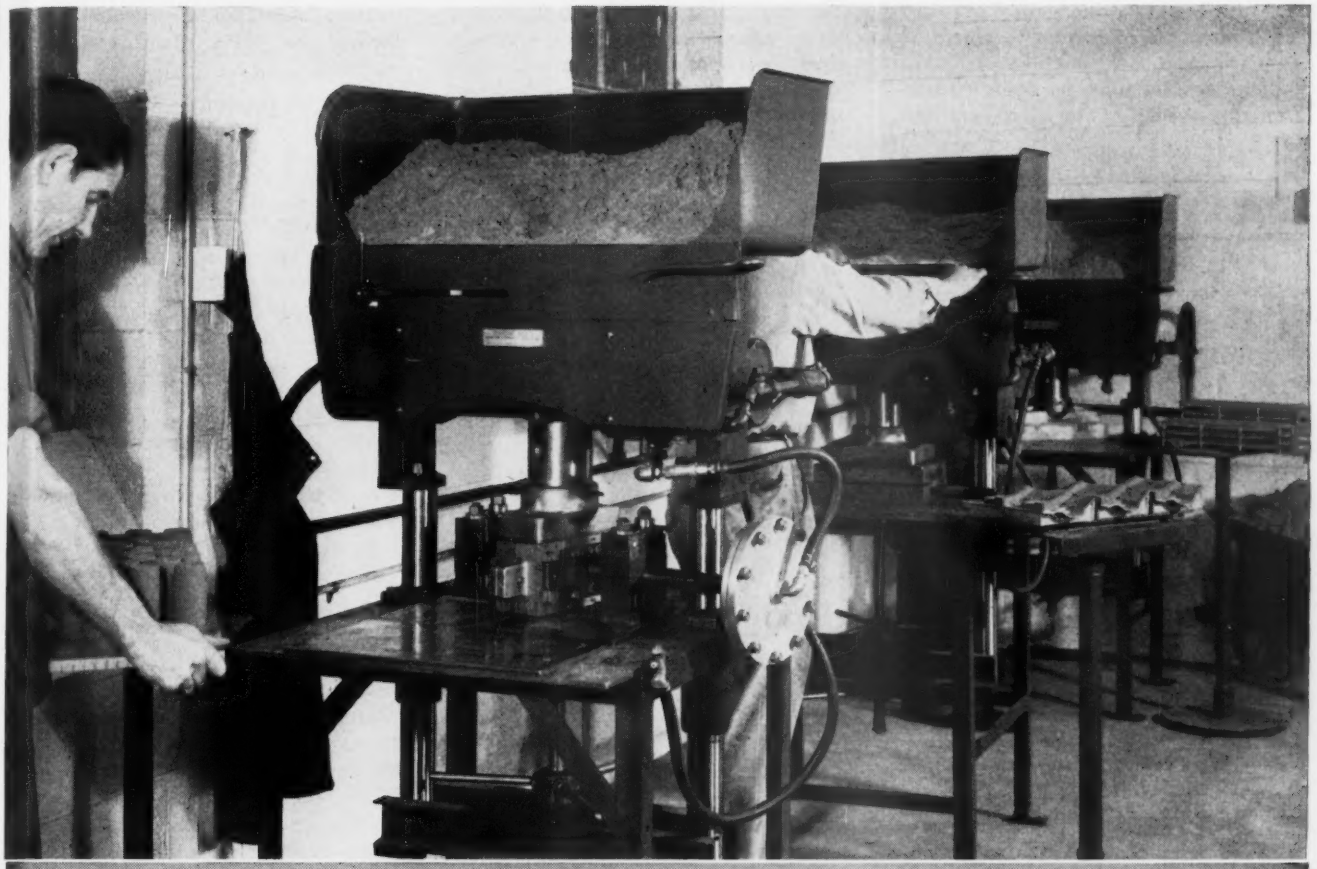

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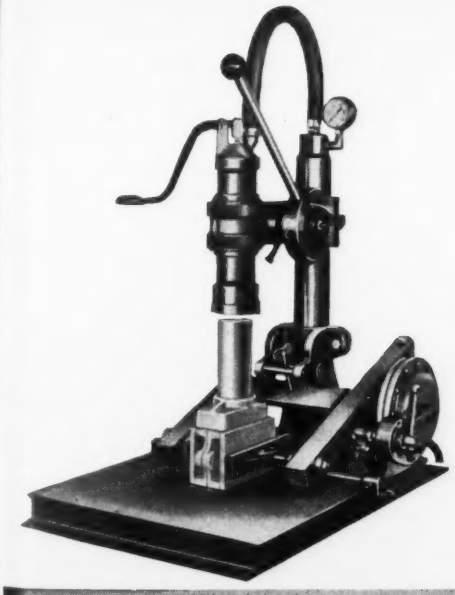

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(*Continued from page* 144)
that when the formulas outlined in the proposed new method are studied the results may be beneficial although several of the listeners felt that too much stress had been put upon space requirements. Theory must be tempered by practicality, since floor space is the cheapest factor involved while labor is highest.

STEEL CASTINGS

THREE papers were scheduled for the opening Steel Division session at which J. A. Rassenfoss, American Steel Foundries, East Chicago, Ind., presided, and H. W. Dietert, H. W. Dietert Co., Detroit, was co-chairman. "Precoat Materials for Investment Casting" was title of the first paper prepared by Lt. William F. Davenport and Adolph Strott, materials laboratory, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, O., and presented by the former.

In investment casting two ways of insuring that the material lining the mold cavity will be of sufficient fineness to produce a smooth casting surface are: (1) Use of an investment material composed wholly of fine particles, or (2) coating the disposable pattern with a thin layer of fine particles before surrounding it with an investment.

At present, the authors know of no one-step investment, one composed entirely of very fine particles, used commercially for alloys melting over 2000° F. Until such an investment is developed it will be necessary to precoat patterns prior to investing. Therefore, a project was initiated to evaluate the more plentiful ceramic oxides offering possibility of use, including those of alumina, silica, zirconium silicate and magnesia. These were evaluated by casting a heat-resistant alloy, a stainless steel and an alloy steel into the precoat mold. Castings were examined to determine best material for each alloy cast.

The authors reported that alumina-silica precoats offer the most promise of fulfilling ideal requirements. The surface oxide on heat-resistant alloy and stainless steel castings is almost eliminated by use of this composition. In case of alloy steels, only improvement noted was that the surface oxide was of the tightly adherent type rather than the scale-like layer found on castings when the standard precoat was used. Precoats of zirconium silicate were found to be comparable to the standard precoat, while the magnesia compositions all produced poor results.

"Contribution of Riser and Casting Edge Effects to Soundness of Cast Steel Plate" was title of the second paper, authored by H. F. Bishop, E. T. Myskowski and W. S. Pellini, Naval Research Laboratory, Washington. Presentation was made by Mr. Bishop. This was the second paper in the study of the subject, the first having been given last year.

The current contribution covered radiographic studies to determine size of sections which can be cast with assurance of soundness. It was stated that, with the riser located at end of the bar, maximum length in which casting will be sound is six times the square root of the bar thickness. In sections 8 x 8-in., convection currents become active soon after pouring. These currents are not observed in section sizes up to 6 x 6 in.

Third presentation for this session was the official exchange paper from the Swedish Institute for Metal Research, Stockholm, Sweden. Titled "An Investigation of the Penetration of Steel Into Molding Sand," it was prepared by Holger Pettersson, research mining and metallurgical engineer, Metallo - Grafiska Institutet, Stockholm. In absence of the author, the paper was abstracted by Chairman Rassenfoss.

The main investigation was based on immersion sand "cores" in molten carbon steel in a high-frequency furnace. It was shown how the rate of penetration varies with time of immersion, metal pressure, temperature and analysis of the steel, grain size of the sand, various additions to the sand, and the like. Standard castings were employed for comparison.

Two methods gave contradictory results as regards effect of certain additions to the sand upon steel penetration. Study of slag formation showed that very little slag is formed at the sand-metal interface before the surface of a casting has solidified definitely. The metal pressure, the capillary forces, the original size of the pores in the sand, the resistance of the sand to enlargement of the pores and the sand temperature are believed by Mr. Pettersson to be the factors which determine the rate of penetration.

Steel roundtable luncheon was held Thursday noon, with Victor E. Zang, Unitcast Corp., Toledo, O., and Don F. Sawtelle, Malleable Iron Fittings Co., Branford, Conn., presiding. Discussion indicated a critical attitude toward the NPA monthly alloy requirement which practically means scheduling 60 days in advance—a nice trick if it can be accomplished in these days. While some were experimenting with boron additions, consistent results were not obtained. Some pointed out the increasing sulphur content of acid steels due to poorer grades of scrap. Latter was believed due to lack of price differential which would be an incentive for scrap dealers to make a separation into acid and basic electric grades.

Three papers were presented at the final steel session. Presiding was Frank Kiper, Ohio Steel Foundry Co., Springfield, O. and George W. Johnson, Vanadium Corp. of America, Chicago, was co-chairman.

Study Effect of Vanadium

First paper was "Effect of Vanadium on Properties of Cast Chromium-Molybdenum Steels," by N. A. Ziegler, W. L. Meinhart and J. R. Goldsmith, Crane Co., Chicago. Mr. Goldsmith presented the paper. Studies were made on steels containing 1.25 chromium-0.5 molybdenum; 2.5 chromium-0.5 molybdenum; and 5.0 chromium-0.5 molybdenum in which vanadium ranged from zero to 0.3 per cent and carbon from 0.1 to 0.3 per cent. Their findings were:

Dilatometric analysis shows that vanadium tends to raise transformation temperatures on heating, particularly for low-carbon and lower chromium steels; vanadium has a slight tendency to increase thermal sluggishness and air hardenability, but this effect is quite small; vanadium tends to spheroidize carbides; spheroidization of carbides is closely associated with the increased transformation temperature; vanadium reduces the size of ferritic and pearlitic grains but makes the dendritic structure more pronounced, persistent and coarser; effect of vanadium on all room temperature physical properties, regardless of chromium and carbon contents (in the presence of 0.5 per cent molybdenum), is relatively small, the trend being to increase the strength and to reduce ductility and impact resistance; in general, in welding these compositions by the metal arc process the presence of vanadium had little effect on physical properties of the resultant weld assemblies—however, five of the 48 welds which failed the bend test contained high vanadium.

Maj. J. H. Savage, Office of the Chief of Ordnance, Washington, presented a paper discussing the me-

(*Continued on page* 149)

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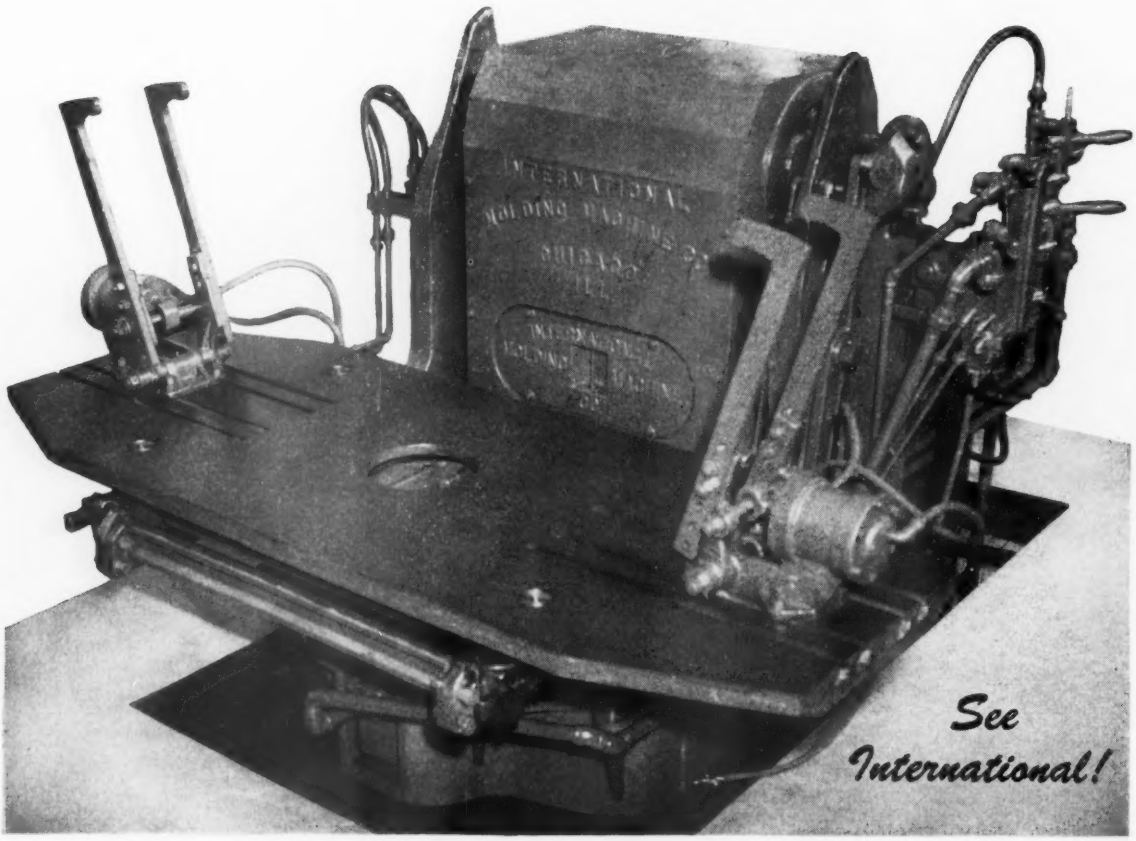

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(*Continued from page* 146)

chanical properties of alloy cast steels. This was prepared in connection with an investigation of a few isolated failures in artillery breech rings. One result of the investigation was to include in the specification for cast gun steel minimum requirements on impact properties.

Sample castings were designed to provide solid metal 4 to 6 in. square with 1 in. coupons spaced around the outer circumference. A similar casting was cored in the center to isolate some metal from the rest of the casting. The study was made of the properties at the outside in relation to the heavy sections. Castings were made from four heats of low alloy steels aluminum killed, and cast in green sand molds. Hardness level was around 250 and all specimens had comparable structure, the grain size varying from 7 to 9. Outside metal and cored center metal showed scattered nonmetallic inclusions, but the solid center metal had a dendritic structure and the nonmetallic inclusions were concentrated along the dendrite lines. In trying to relate tensile properties with the agglomerates of the nonmetallics of the solid center coupon, relationship was found between failure of the test specimen and the position of the nonmetallics. Chemical analysis indicated the carbon content was less at the center of the 5-in. sections than at the outside or at the center of the cored specimens.

Give Test Casting Treatment

Major Savage stressed the importance of positioning and feeding the test coupons and also recommended that they be given the same heat treatment as the castings. Even though properties of the coupons might not be representative of the properties of the casting, the relationship between the casting and the test coupon would be consistent.

Final paper of the session, entitled "Usefulness and Ill Effects of Gases in Metallurgy," was presented by Dr. Etienne Spire, Canadian Liquid Air Co. Ltd., Montreal, Que.

Dr. Spire referred to the ill effects of hydrogen in ferrous metals. It is particularly troublesome because it is soluble at high temperatures. Remedial measures were discussed, principally use of inert gas. He then explained a gas flushing ladle developed recently through the combined research of the Canadian Liquid Air Co. Ltd., the Physical Metallurgy Laboratories of the Canadian Bureau of Mines and Canadian Refractories Ltd. Gas is introduced into the ladle by a porous refractory insert plug set in the refractory bottom, below which is a pressure chamber with pipe connection for introducing nitrogen or argon. Efficiency of the flushing action of the gas is greatly increased by its fine dispersion. A bottle of compressed gas can be attached to the ladle and the flushing action take place between filling the ladle and pouring. This minimizes drop in metal temperature. Expansion of the gas in the cylinder is sufficient to keep the gas cool even though attached to hot ladle.

GRAY IRON SHOP COURSE

AIR in the cupola was the subject under consideration at the first of the Gray Iron Division's three shop course sessions. W. W. Levi, Lynchburg Foundry Co., Radford, Va., was chairman and E. J. Burke, Hanna Furnace Corp., Buffalo, was co-chairman.

Opening the discussion, D. E. Krause, Gray Iron Research Institute, Columbus, stated that the three fundamental factors in the cupola air problem are temperature, pressure inside the cupola, and humidity or water content. In nearly every case several modifying features are present and must be taken into consideration. In a blackboard demonstration he showed the difference between hot, dry air at 100° F and cold damp air at 40° F. The blower might deliver the same volume of air measured in cubic feet in both instances, but the oxygen content of one, the only element of any value entering the cupola, would be far different from the other.

In a general reference to several types of blowers used in the foundry, he mentioned that comparatively recent types of centrifugal blowers are equipped with a device which automatically compensates for variations in temperature and moisture content. He also stated that the subject was treated in a great deal more detail in the *Cupola Handbook,* published by the AFS and now in the course of revision.

He next touched upon the subject of the blast pipe. A straight pipe is preferable, but if a bend is necessary, it should be a gradual curve. An appreciable loss is incurred where the air stream has to pass a right angle corner or a sharp curve.

While a hot blast is a comparatively recent development, it has proved its worth where conditions are favorable. The speaker described installations where the spent gas from the stack is utilized, and others where hot air from an outside source is employed.

The second gray iron shop course was presided over by E. J. Burke, Hanna Furnace Corp., Buffalo, and Howard H. Wilder, Vanadium Corp. of America, Detroit. In discussing melting gray iron in the reverberatory-type furnace, J. G. Winget, Reda Pump Co., Bartlesville, Okla., described the application of this type furnace to the production of small heats, particularly those involving alloy additions, nodular iron, and installations where use of the cupola is not desirable.

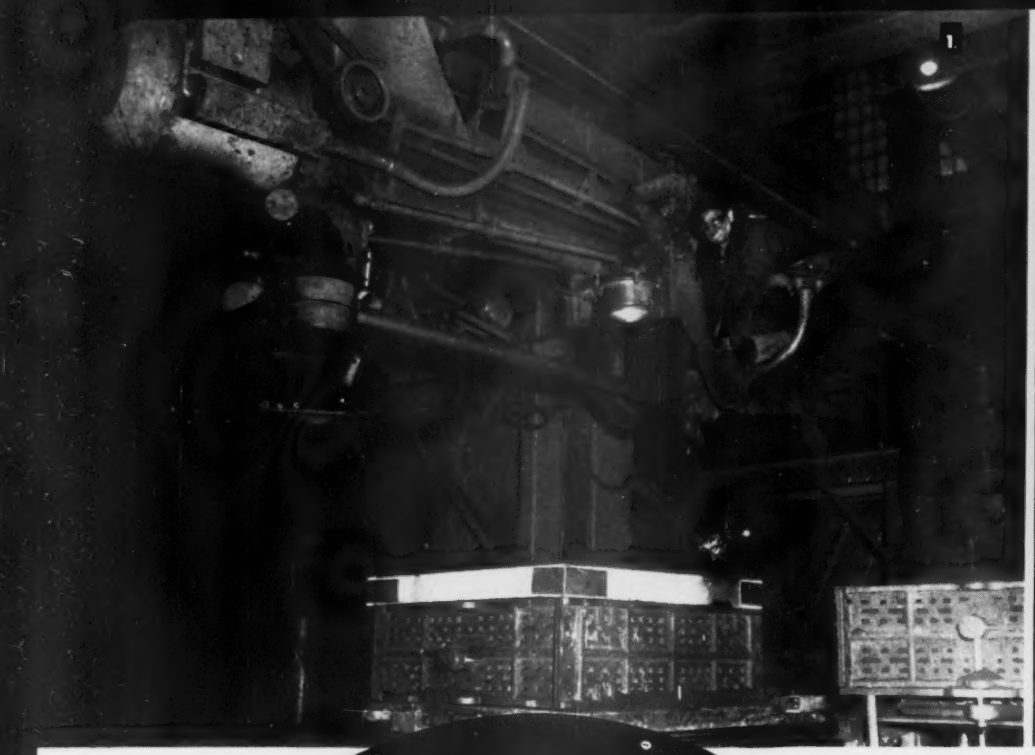
These advantages were offered for use of the reverberatory-type furnace: 1. High melting rate. 2. Consistently high level of physical properties. 3. Ease of operation. 4. Low maintenance cost. 5. Low fuel cost. 6. Low metal loss. 7. Desirable working conditions. 8. Low initial cost per unit production of comparable quality. 9. Flexibility of operation.

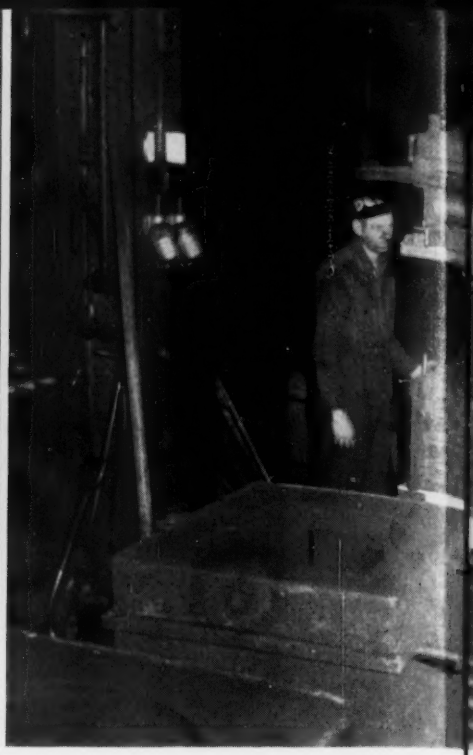
The 1000-pound capacity Reda furnace was said to average 21 minutes per heat in gray iron melting with an average gas consumption of 3100 cu ft of 1040-Btu heat content. Minimum tap temperature is 2850° F. The furnace is estimated to give 300 heats per lining; at a cost of $175 for relining, the refractory cost is less than 60 cents per heat. This furnace also is available in 400 and 550-lb capacities. Mixing action of the furnace flame is said to be ideal for alloy work, and it was also stated that tensile strength of iron is increased an average of 15 to 20 per cent.

"Metal Pouring Temperature Control" was the subject for the third and concluding session of the Gray Iron Shop Course, Ralph A. Clark, assistant manager—development, Electro Metallurgical Division, Union Carbide & Carbon Corp., Detroit, was discussion leader. K. H. Priestley, Vassar Electroloy Products Inc., Vassar, Mich., presided, and E. J. Burke, Hanna Furnace Corp., Buffalo, was co-chairman.

Mr. Clark pointed out the high cost of melting iron to an initially high pouring temperature and the wastefulness of permitting excessive loss in temperature through faulty methods of handling the metal and transporting it to molds. He covered control of the temperature decrease from the time metal is tapped to the time it is poured into molds, stressing particularly the amount of temperature loss to be expected each time metal is transferred from one

(*Concluded on page* 152)





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ANNUAL PRODUCTION UP

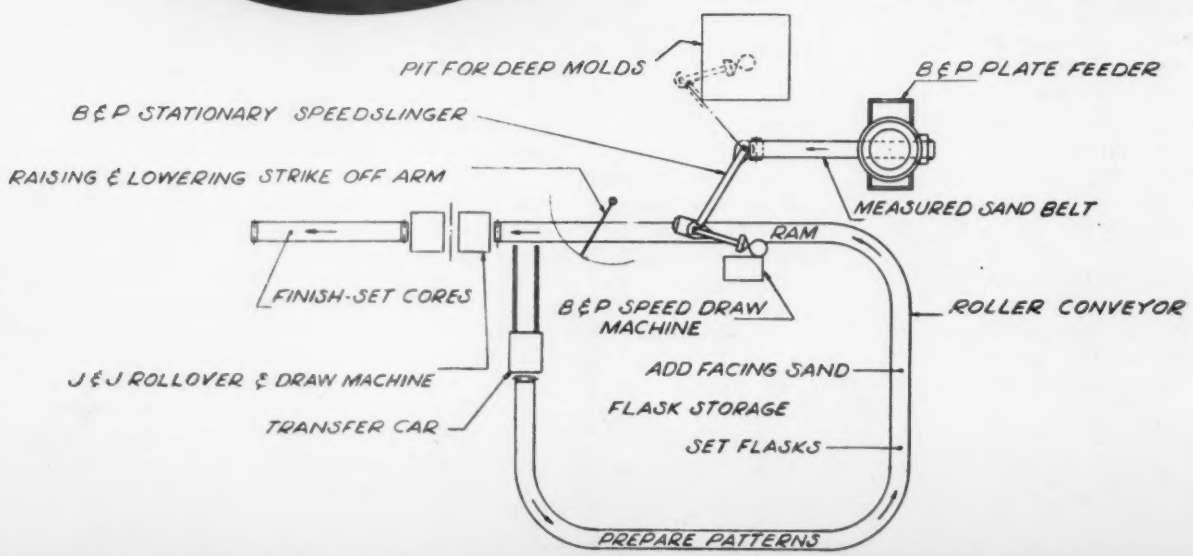
3,000,000 lbs.

1. One Speedslinger rams flask work on both a loo roller conveyor and on a B&P Champion Spee Draw machine. It also rams pit work in a 12 x foot molding pit.

2. Many of the molds rammed at D. J. Murray quire the very accurate draw of the Johnson & Je nings rollover-draw machine. It handles all of molds rammed on the roller conveyor unit.

3. A Model 3½ Mulbaro is used to mull all of t core sand required for special all-core molds D. J. Murray. These molds—for thin radiator sectio —are poured at high temperatures. The sand m have maximum physical properties and must be ve thoroughly mulled.

This unit led to an increase of over 50% in the ma hour productivity of molders at the D. J. Murra Company, Wausau, Wisconsin and increased t foundry's capacity by 3,000,000 lbs. a year.



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A new Stationary Speedslinger molding unit at D. J. Murray Co., Wausau, Wisc., has increased productivity from 220 to 350 lbs. of finished salable castings per direct molding man-hour, and annual production has been increased by over 3,000,000 lbs. of castings. The Speedslinger rams molds on a loop roller conveyor, on a B&P Champion Speed-Draw machine, and in a 12 x 12 foot molding pit. Molds rammed on the roller conveyor are rolled over and drawn on a Johnston & Jennings rollover-draw molding machine. A 6% saving in metal has been effected because of truer-to-pattern ramming. Thirty-five to forty pattern changes are made each day *as production continues at an uninterrupted pace.*

Here's another foundry where slinger mechanization has brought about increased production and greater profits. Whether you operate a production or jobbing foundry, it will pay you to investigate . . . write today!

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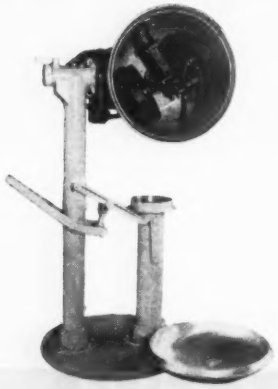

Better sand control means better castings —less scrap—lower production costs! The Laboratory Mulbaro—today's answer to thoroughly and uniformly mulled test batches—gives you *accurate* results. Two or more mixing bowls may be used with one machine permitting several mixtures to be tested without contamination of one batch by another — without loss of time. Removable mixing bowl and pivot mounted mulling mechanism permit easy cleaning.

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(*Concluded from page* 149)

ladle to another; effect of using covered and insulated ladles in control of temperature loss; amount of loss to be expected when using a receiving ladle, and such related subjects.

Also discussed were methods of obtaining a rapid decrease in metal temperature when it is desired to have low temperature metal for pouring heavy-section castings.

Refractories

LADLE refractories and practice in acid electric steel foundry were described in a paper presented by Clyde H. Wyman, chief metallurgist, Burnside Steel Foundry, Chicago, at the Refractories Committee technical session. R. H. Stone, Vesuvius Crucible Co., Pittsburgh, and R. P. Schauss, Illinois Clay Products Co., Chicago, presided.

In the author's opinion, study of the behavior and characteristics of refractory materials of monolithic linings in the steel foundry industry is interesting and also mystifying. With supposedly the same identical service conditions and the same refractory materials one seldom sees where two foundries can accomplish the same results. Obviously, there is an unknown or hidden factor which enters into the picture. The claim is advanced that the raw materials are not consistent; preparation of the materials or method of application may be responsible; or the thermodynamic reaction not always apparent, which causes excessive deterioration.

Side-stepping all the variables which might be encountered, the author approached the problem to determine the effect of grain size and grain distribution of ganister in an effort to increase ladle lining life. This would mean a reduction in cost and, perhaps what is more important, cleaner metal. Investigation was carried through an extensive period, starting with the coarser ganister specified as ¼-in. and carried down gradually to a grain size that left 40 per cent on a 50-mesh screen. The remainder falling into the pan could be classified as 1/16-in. and down.

Results from a service standpoint indicate that the size of the grain aids in promoting desired density. As a result of the investigation the lining life of teapot and small bottom-pour ladles has been more than doubled. At the beginning of the investigation the author considered himself fortunate in getting 40 to 60 heats from a lining. Today he is getting 200 to 250 heats from a lining.

Melting Brass and Bronze

(*Continued from page* 89)

gas absorption in the solid state at temperatures above red heat depends in part on the surface area presented to absorbable gases, this again reduces the chances for excessive absorption of hydrogen gas. Third, since heavy melting losses will occur where charges of large surface area per unit weight are exposed at high temperatures for long periods before melting, this method of charging definitely assists in cutting melting losses.

Care should be taken with the gas or oil fired crucible furnace that no portion of the charge protrudes over the edge of the crucible and into the products of combustion from the burner. Direct contact of the charge at red heat with these combustion products only increases the volume of hydrogen absorbed and, in addition, causes unduly high melting losses. With the gas or oil fired reverberatory furnace it is impossible to keep the charge away from some contact with the products of combustion. It is possible, however, to prevent portions of the charge being placed in the direct path of the burner flames and this alone will markedly decrease the chance of heavy hydrogen absorption and of high melting losses.

Absorbs Gas in Furnace

With the coke-fired crucible furnace the combustion products will consist largely of carbon dioxide, carbon monoxide and nitrogen, since coke contains little or no hydrocarbons. Although these compounds are considerably less dangerous than those resulting from the combustion of gas or oil, the presence of carbon monoxide and the possibility of the water vapor and carbon monoxide reaction occurring, together with the ever-present chance of high oxidation losses, is sufficient to warrant avoidance of direct contact of the charge with the products of combustion. With the electric arc furnace the important point is to prevent any portion of the charge from interfering with proper arcing conditions. Poor arcing produced by the intervention of the charge between the electrodes will prevent rapid melting and, by the liberation of particles of carbon at high temperatures, will permit the reduction reaction between water vapor and carbon with the formation of hydrogen. Where the high-frequency lift coil induction furnace is used there will be, of course, no products of combustion and no arc, and it will be immate-

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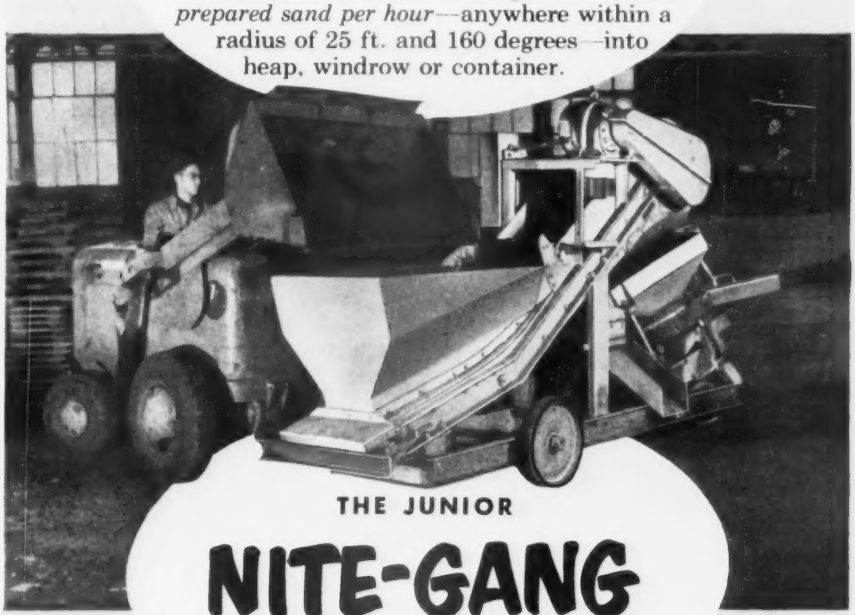
Want a *clean, aerated, thoroughly screened* molding sand . . . prepared *on the floor . . . wherever* you need it? Today's answer is the Junior Nite-Gang! Simply move it to the shakeout sand—it magnetically separates, screens, aerates and discharges *40 tons of prepared sand per hour*—anywhere within a radius of 25 ft. and 160 degrees—into heap, windrow or container.



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rial whether or not portions of the charge protrude over the edge of the crucible.

Melt Covers — Unless under very special circumstances, I do not favor use of covers in melting brass or bronze. A charcoal cover, for example, is frequently recommended for use in gas or oil fired crucible melting on the theory that the charge will thereby be protected from oxidation and from the products of combustion. The protection afforded here, it should be understood, is quite often valueless.

Consider the case where a solid charge is made to a gas or oil fired crucible furnace, the charging being done either by alternating charge portions with charcoal lumps or by covering the entire charge with a heavy layer of lump charcoal. In spite of the cover the charge, before melting, while red hot and while in the mushy stage, will be afforded ample opportunity to absorb hydrogen gas from water vapor breakdown alone. The melt thus obtained, having now absorbed an appreciable volume of gas, will no longer be able to make contact with any excess oxygen in the combustion gases, since the charcoal cover will now tend to prevent such a contact. Therefore, there will be no opportunity for the melt to be degassed by the oxidation of its contained hydrogen.

A still more serious situation can and does frequently exist. The charcoal cover, at high temperatures and in slightly oxidizing furnace atmospheres, will tend to form carbon monoxide gas and this gas will, by combination with water vapor, yield hydrogen. The use of a charcoal cover will then, in many cases, defeat its own purpose and will at least prevent a proper cleansing of the melt by hydrogen oxidation, if not actually generating hydrogen for melt absorption.

The use of a glass cover, and indeed of most other covers, is objected to for the same general reason, namely that the cover prevents a proper contact between the melt and such minor quantities of oxygen as may exist in the furnace when it is operated under slightly oxidizing conditions.

Furnace Atmosphere — Melting under slightly reducing conditions in the gas or oil fired crucible or reverberatory furnace, to prevent excessive oxidation losses and to obtain a highly liquid, easily removed slag, is carried out to a considerable extent by the ingot manufacturers and by some brass and bronze casting foundries. Since this involves the combustion at the burner of a mixture where the fuel is slightly in excess of the supplied air, the resulting furnace atmosphere will contain hydrogen, carbon monoxide and possibly unburned hydrocarbons, as well as the regular products, carbon dioxide, water vapor and nitrogen. There will be, of course, no appreciable oxygen content. A melt obtained under these conditions will nearly always contain a significant volume of absorbed hydrogen. To degas this melt the furnace operator must, before pouring, either expose it for some time to an oxidizing furnace atmosphere or flush it with air or nitrogen gas. Melting under reducing conditions, while possessing certain well-defined advantages, should never be performed except where a definite operating procedure has been established by conclusive experimentation.

By far the best operating procedure, when using gas or oil fired units, is to melt under slightly oxidizing conditions. This requires a burner mixture having an excess of air over fuel. The resulting furnace atmosphere will contain carbon dioxide, water vapor, nitrogen and a small concentration of oxygen. The oxygen content for slightly oxidizing atmospheres is approximately 0.1 to 0.4 per cent. Hydrogen, carbon monoxide and unburned hydorcarbons will either be absent or will be insignificant in their concentrations.

The main difficulty in operating gas or oil fired crucible or reverberatory furnaces under oxidizing conditions is that of determining exactly when the proper atmosphere has been obtained. Too little burner air will lead to undesirable neutral or reducing atmospheres, while too much will result in a strongly oxidizing atmosphere with high oxidation losses in melting.

Adjust the Burner

Where the furnace unit is equipped with a proportioning burner, and where the gas or oil pressure and the air pressure are comparatively constant, this difficulty is minimized. The products of combustion emerging from the unit can be checked with an Orsat gas analyzer and the burner adjusted until the correct oxygen concentration exists in the furnace atmosphere. This atmosphere will then remain relatively constant regardless of the flame size used.

Where proportioning burners are not available, and where gas or oil pressures and air pressures are subject to periodic fluctuations, the problem of maintaining the correct range of oxygen concentration becomes acute. The use of the Orsat apparatus to analyze the exit gases is superfluous, since fluctuations in the air-fuel compostion may occur at any time. The best criterion of proper furnace operation under these conditions is the apearance of the exit flame from the unit. For slightly oxidizing conditions this should have a blue or a blue-green tinge. The Orsat apparatus can be conveniently used as a means of judging the flame color indicative of the desired oxygen range. Constant supervision by the furnace operator will be essential to maintain the proper flame color, and it goes without saying that the degree of control exercised by the operator will determine the quality of the melt.

With the coke-fired crucible fur-

(*Continued on page* 156)

PRODUCTIVITY TEAM, consisting of British executives, technical experts, and labor representatives, recently visited the United States under auspices of the Anglo-American Council on Productivity and the Economic Co-operation Administration. The team studied administration, layout, plant methods and operating conditions in the American zinc and aluminum die casting industry, as well as applications of die cast products. The plant of Ajax Engineering Corp., Trenton, N. J., was the first stop in the team's tour. Company officials acting as hosts were: Manuel Tama, vice president; Mario Tama, secretary; Alfred A. Coley, sales engineer; W. E. Shearman, research engineer; H. F. Gauker, engineering department, and Henry Faske, representative of local 761, U.M.W. Photo through courtesy of Ajax Engineering Corp., Trenton

SOFFEL'S
New THERMOTOMIC-X
(PATENTED)

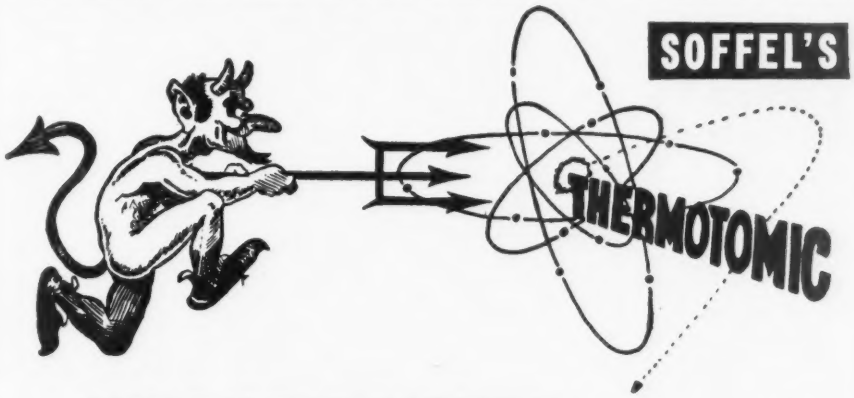
exothermic metal feeding compound

√ Cuts Casting Costs

√ Makes Better Castings

FOR STEEL, STAINLESS STEEL, GRAY OR MALLEABLE IRONS, COPPER, BRASS, BRONZE AND ALUMINUM

A new, improved, hotter and faster acting THERMOTOMIC X will increase temperatures and fluidity in the risers without bubbling and boiling. A means of introducing heat energy into the feeding metal in the heads or risers of castings or at other localized points in the mold by the use of inserts or as a facing. Increased yield by the reduction of heads, control of directional feeding and the elimination of scrap due to piping, porosity and shrinkage are the results to be obtained by the use of this patented compound. Thermotomic ABC and AL-X31 Liquidizer are recommended for aluminum.



Reduces Size of Risers and Feeder Heads

Heads and Risers Removed without Cutting and Burning

Increases Yield

Eliminates Shrinkage and Piping in Castings

WHAT IS THERMOTOMIC?

Thermotomic Compound is an exothermic material which can be molded and baked into any desired shapes just as sand cores are made. It produces a temperature of 3500° F. It is used as ring inserts with 1¼" feeding ring inserts under the risers or feeding heads, or as facing inserts where it is desirable to maintain the fluidity of the metal in the mold at those points where rapid cooling may cause piping, shrinkage or segregation. Great savings are realized through reduced riser dimensions and cleaning costs. For use in green sand molds, use Thermotomic WP (waterproofed). Soffel's Carbon-Free Liquidizer No. 5 is recommended for use with Thermotomic feeding compounds on top of the feeding heads.

EXOTHERMIC CARBON FREE LIQUIDIZER

SOFFEL'S EXOTHERMIC CARBON FREE LIQUIDIZER is the leader in major foundries for use on ferrous and nonferrous metals, and in ingot production. It is the first and the original scientific non-carbon exothermic compound for feeding heads and risers.

SOFFEL'S EXOTHERMIC CARBON FREE LIQUIDIZER is different from ordinary head compounds in two ways: It is CARBON FREE, thereby eliminating carbon pick-up. It is EXOTHERMIC. Carbonaceous materials, regardless of their composition, will cause carbon pick-up, segregation, non-uniform grain structure and hard spots under risers and in castings. Carbonaceous materials contribute no added heat value or increased temperatures to the feeding metal and only act as an insulating cover.

SOFFEL'S EXOTHERMIC CARBON FREE LIQUIDIZER reacts within itself exothermically, producing a temperature above 3200° F. actually increasing the temperature of the feeding metal to a point well above that of the metal in the main body of the casting, thus ensuring that the feeding metal will be the last to freeze. Shrink cavities in the casting caused by premature freezing of the feeding metal are eliminated. After the exothermic action has ceased, the LIQUIDIZER forms a soft insulating blanket on the metal. This confines the heat generated by the LIQUIDIZER and aids in maintaining the desired high temperature of the feeding metal in the heads.

THERMOTOMIC HOTOP CARBON FREE LIQUIDIZER

SOFFEL'S THERMOTOMIC HOTOP CARBON FREE LIQUIDIZER is for castings of iron and steel. A new exothermic compound which produces over 4000° F. of heat. It is used for dissolving and reducing skulls in ladles of iron and steel and on the feeding heads and risers of castings and also for ingot hot-topping. SOFFEL'S THERMOTOMIC HOTOP will permit reducing feeding heads from 60 to 70% or the height as low as one-half the size of the diameter.

For ladle use when SOFFEL'S THERMOTOMIC HOTOP is applied to cold, sluggish metal of iron or steel on the surface of the metal, the exothermic action of THERMOTOMIC HOTOP increases the temperature several hundred degrees and adds fluidity. It will save much metal which would have been discarded as scrap. THERMOTOMIC HOTOP is guaranteed not to change the chemical analysis of iron or steel, as it is carbon free and is recommended only for ferrous use.

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Pittsburgh Metals Purifying Co.

Manufacturers of Quality Fluxes and Purifiers for All Metals and Alloys

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(*Continued from page* 154)

nace the same general conditions apply and the furnace atmosphere should be on the oxidizing side. Should the coke bed receive insufficient air for proper combustion large volumes of carbon monoxide will be found in the furnace atmosphere and, as already mentioned, this is a dangerous combustion product.

Electric furnaces of the arc or the high-frequency induction type operate normally with neutral furnace atmospheres free from large concentrations of gases such as hydrogen or water vapor. The arc furnace atmosphere will usually contain appreciable quantities of carbon monoxide, but this will be of little importance providing the water vapor content is kept to a low value. Moist charges or poorly dried furnace linings will, of course, negate the advantages of the neutral atmosphere.

Temperature and Time—Under no circumstances should a melt be raised to a temperature much in excess of the required withdrawal temperature. Overheating must be avoided at all times. For any given melt required to pour a casting or a group of castings there will be a minimum temperature at which the melt can be withdrawn from the furnace. This minimum temperature may vary from melt to melt, but it should not exceed by more than 100°F the correct pouring temperature for the casting, or the average pouring temperature for the group of castings. The withdrawal temperature should preferably be approximately 50°F higher than the necessary pouring temperature. The fact that the solubility of hydrogen gas increases with increasing melt temperature, where brass and bronze alloys are concerned, provides the reason for avoiding overheating.

Time in the furnace is equally as important as temperature. Once a melt has reached the proper temperature for withdrawal it should not be retained in the furnace any longer, even when its retention is not accompanied by any further rise in temperature. Hydrogen absorption by molten brass or bronze alloys is governed, in part, by the time of exposure to hydrogen-bearing atmospheres. We should therefore avoid prolonging the period during which any melt is in contact with hydrogen gas.

Deoxidizers and Degassers — Melts of pure copper may be deoxidized by means of various deoxidizers. The use of substances such as phosphor copper, silicon copper or even zinc metal is quite satisfactory providing the melt is not required for the production of high-conductivity copper castings. The residual left in the melt by these deoxidizers has a very adverse effect on the electrical conductivity. Where the conductivity is of prime importance deoxidizers such as calcium boride, calcium copper or lithium copper should be used.

It should be stressed that all of these deoxidizers have some effect as degassers also, where pure copper melts are concerned, although the latter three are by far the most efficient in this connection. I prefer the use of calcium boride as a combined deoxidizer and degasser of pure copper melts for electrical conductivity work. The mechanism by which this degassing action is accomplished is imperfectly understood, but it is thought to be not so much the removal of absorbed hydrogen itself as the removal of copper oxide by reduction, thereby preventing the formation within the melt of water vapor by the reaction of hydrogen with copper oxide.

Melts of pure copper containing hydrogen but no initial copper oxide, if not given an addition of a deoxidizer, are prone to form water vapor internally upon being removed from the furnace and brought into contact with the atmosphere. Atmospheric oxygen will form copper oxide at the melt surface and this oxide, dissolving in the melt, will react with hydrogen to form water vapor. The addition of a deoxidizer upon removal from the furnace eliminates water vapor formation by preventing copper oxididation at the melt surface.

Contain Dissolved Metallic Oxides

Melts of copper-tin, copper-tin-lead or copper-tin-lead-zinc alloys, when obtained from furnaces operated in a manner eliminating or minimizing hydrogen absorption, will contain dissolved metallic oxides. These are best deoxidized by additions of phosphor copper of the order of 2 to 3 oz per 100 pound of melt. The degassing action of phosphor copper is negligible where these alloys are concerned and, where melting conditions are such as to have permitted hydrogen absorption, the melt should be swept with water-free air or nitrogen prior to pouring the castings.

The high-zinc brasses and the manganese bronzes are not usually prone to absorb hydrogen gas, even when melted under slightly reducing furnace atmosphere conditions. The high zinc content and the high heat of formation of zinc oxide is felt to afford the necessary protection here. Alloys of this class do not require the addition of deoxidizers. Where

(*Concluded on page* 158)

FEF—STUDENT DINNER was held recently at Purdue University, West Lafayette, Ind., with about 75 faculty members, foundry students, and foundrymen present. Views of the speakers' table are shown above. At top, left to right, are: George K. Dreher, executive director, Foundry Educational Foundation, Cleveland; Stowell Wasson, National Malleable & Steel Casting Co., Cicero, Ill.; F. Lynn Cason, director of placement, engineering and science schools, Purdue, and G. M. Enos, department of metallurgy, Purdue. Lower photo: L. L. Andrus, American Wheelabrator & Equipment Corp., Mishawaka, Ind.; Prof. H. A. Bolz, general engineering department, Purdue; Claude B. Schneible, Claude B. Schneible Co., Detroit, chairman, FEF, and Paul Harlan, Electric Steel Castings Co., Indianapolis

Dust Control System on Rotary Breaker Screen and sand handling system in a casting plant of one of the nation's largest steel companies.

The large volumes of dust produced in the sand handling operations of this plant are not a problem. As soon as dust is formed, it is removed by the KIRK & BLUM Dust Control System.

One of the many KIRK & BLUM foundry installations, this Dust Control System meets every requirement of the American Foundrymen's Association code; heavy gauge piping has flanged joints and convenient clean-out doors.

Hundreds of plants, large and small, have found it pays in *greater operating efficiency* to have a dust or fume control system designed and installed by experts. For all three—design, fabrication and installation—call on KIRK & BLUM.

If you need a new dust control system . . . or more capacity in an existing one, contact KIRK & BLUM. They'll gladly prove the money-saving efficiency of systems by KIRK & BLUM, specialists in dust and fume control for more than 43 years. For Booklet, write The Kirk & Blum Mfg. Co., 3108 Forrer St., Cincinnati 9, Ohio.

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FOR CLEAN AIR... THE INVISIBLE TOOL

KIRK AND BLUM

DUST CONTROL SYSTEMS

(*Concluded from page* 156)

melts of the high-zinc brasses or the manganese bronzes do become gassed by hydrogen, flushing with water-free nitrogen gas will serve to expel the absorbed hydrogen. Air flushing is not recommended on account of the high zinc losses that occur.

Alloys of the copper-silicon or copper-aluminum group are quite sensitive to the nature of the furnace atmosphere, and should be melted under slightly oxidizing conditions, whenever gas or oil fired furnace units are used. Deoxidizers should not be added to melts of these alloys as the silicon or aluminum contents provide adequate deoxidation. Where gassed melts are obtained sweeping with water-free nitrogen will serve to degas.

Copper-nickel alloys, with high nickel contents and low zinc contents, are very prone to absorb hydrogen and an oxidizing atmosphere is essential in gas or oil fired melting. Manganese copper or magnesium should be used as deoxidants for these alloys. Gassed melts may be degassed by flushing with water-free air or nitrogen gas.

Melting Equipment—The gas or oil fired crucible furnace possesses certain well-defined advantages. These include the rapidity of melting, the comparatively low melting loss, the economy of equipment and installation, the flexibility of change-over to different alloys and the economy of operation where intermittent production is an essential part of the operating schedule. The disadvantages are also well marked. The possibility of poor melt quality being obtained is always present, unless proportioning burners, constant oil or gas pressure and air pressure and experienced supervision are available. In addition, the cost of replacing crucibles and the limited charge weight capacity are factors to consider. Units of this type are best suited to use in small or medium size production foundries, where the advantages cited apply to a large degree and where the available capital outlay will not extend to the use of furnaces of the electric type.

Reverberatory furnaces, either gas or oil fired, are very economical from the points of view of initial cost, installation and operation. Their rapidity of melting and their large range of melting capacity render them extremely valuable for the medium or large size foundry, particularly where the casting weight must vary considerably. They are also well suited to intermittent production, there being no loss of economy from fixed charges. Such units possess, however, distinct disadvantages, particularly where where melt quality is involved.

Direct contact of the melt with the furnace atmosphere, over a large melt area, increases the possibility of hydrogen absorption, and proportioning burners, constant gas or oil and air pressures and experienced supervision are essential. In addition, exposure of large melt areas to the products of combustion leads to relatively high melting losses. Finally, as is the case with all stationary furnaces, the flexibility of change-over from one alloy to another is good only where the alloy types are compatible.

The electric arc furnace possesses the advantages of low melting loss, good melt quality, rapid melting rate and good range of melting capacity. In addition, units of this type are capable of excellent melt temperature control. Among the disadvantages of electric arc furnaces may be listed their high initial cost for equipment and installation and their high operating cost where intermittent production is unavoidable or where electric power is not easily obtainable. The fact that they are, like the reverberatory furnaces just discussed, stationary units limits their flexibility of change-over to different alloy types. The electric arc furnace is suitable for use in all classes of brass or bronze foundries, providing power is available, continual use permits economical operation and providing that the consumption of some given alloy or group of compatible alloys will be sufficient to avoid frequent change-overs.

The high-frequency lift coil induction furnace until recently was not quite so efficient a unit as the electric arc furnace. In addition, the initial cost of equipment and installation is higher. As with most electric furnaces the economy of operation depends on an absence of intermittent production. Definite advantages exist, however, some of these hinging on the fact that the lift coil furnace is a crucible unit and therefore possessed of the general advantages of this type of melting unit. Excellent melt quality, ease of temperature control, very rapid melting rate, flexibility of change-over from one alloy to the other and very low melting loss are among other advantages.

Capacity Is Limited

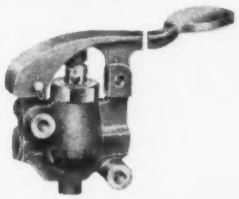
As with all crucible units one of the main disadvantages is the limitation of charge weight capacity. This type of melting unit is of very great value, in all sizes of brass and bronze foundries, in the rapid production of small individual quantities of alloys. In large foundries, or in medium foundries periodically manufacturing large castings, the induction furnace is valuable as a source of metal for continuous small casting production work but will be of little value in the periodic production of large quantities of metal for large castings. In small or medium foundries, where large casting weights are not required, the induction furnace would be an excellent unit, providing always that the operating conditions of best economy could be met and that available capital would be adequate.

It should be remembered that, while the gas or oil fired crucible or reverberatory furnace has a definite refining action by oxidizing certain impurities during the melting cycle, the electric furnaces possess no such advantages on account of their neutral atmosphere. Great care must therefore be taken to prevent contamination of electric furnace charges by impurities of this type.

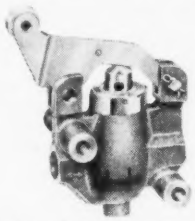
NEW LABORATORY BUILDING: Construction of a new laboratory building for Battelle Memorial Institute, Columbus, O., has been approved by National Production Authority. The addition will be Battelle's fifth in a decade and will provide expanded facilities for research services in behalf of the nation's defense effort. The 3-story structure with two bays for pilot plant operations will provide approximately 80,000 sq ft of work area and will house 115 unit laboratories

Schrader Valves—Practical answers to air control problems

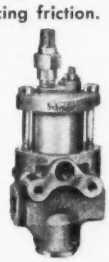
To meet the vast and increasing variety of applications for air cylinders and other air line accessories, Schrader supplies a comprehensive range of equally useful control and operating valves for operation by hand, foot or cam. Shown below are just a few from Schrader's more than a hundred models.



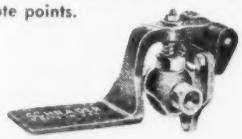
Hand Lever—This is one of the many Schrader hand operated valves. Brass body with stainless steel parts. Can be mounted rigidly at any angle. Specially constructed lever makes operation easy and safe.



Valves with roller lever—These valves are designed for any cam actuation. The free turning roller riding on a cam provides long life by reducing friction.



Pilot valves—Both two and three way, with or without timer. Normally open or normally closed. Provides instant power at remote points.



Foot Lever—This valve supplies line pressure to single acting cylinders. It is functionally designed for "tip-toe" operation.

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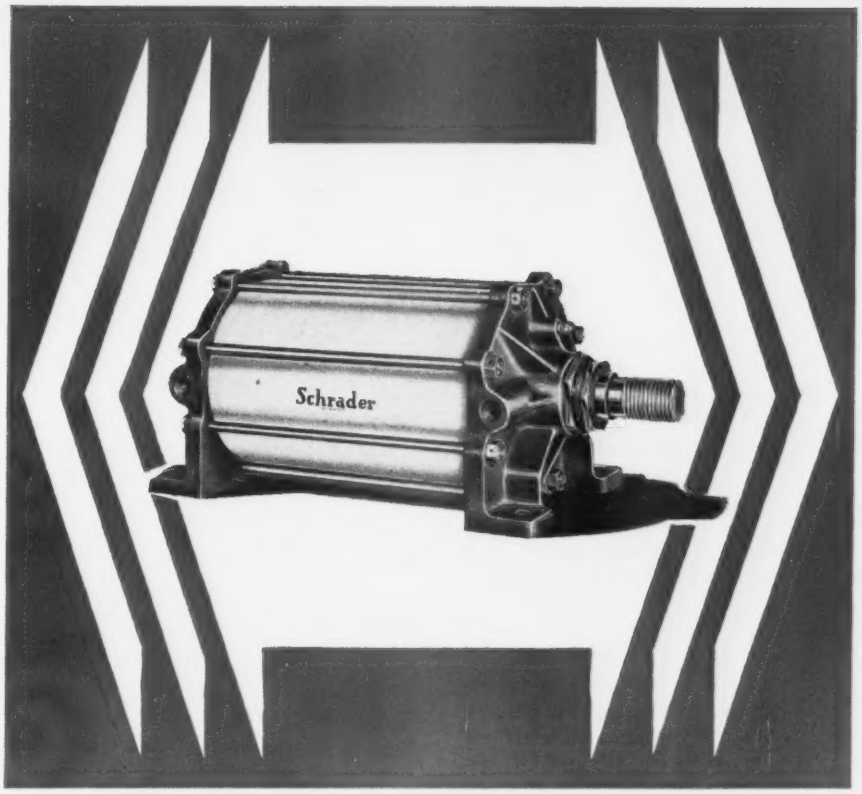

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By EDWIN BREMER

Foundry DEVELOPMENTS

INVESTIGATION of magnesium's applicability in removing sulphur from steel is being conducted by Canada Department of Mines & Technical Surveys in co-operation with the Steel Castings Institute of Canada, according to *Canadian Metals,* May issue. Results obtained so far indicate that use of 50-50 Al-Mg alloy intimately mixed with dried lime alone or in combination with other slagging agents shows a reduction in sulphur content of 0.010 to 0.015 per cent regardless of whether the initial sulphur content is 0.030 or 0.050 per cent. Amount of Al-Mg alloy per ton of steel is 2 lb with 20 lb lime.

♦ ♦ ♦

FASTER and more accurate method for detecting the size and quantity of silica in dust has been developed by Bausch & Lomb Optical Co., Rochester, N. Y. Procedure is to place dust sample on a glass slide and add a drop or two of a liquid having the same refractive index as free silica. The preparation then is examined with either a dark-field or phase-contrast microscope employing polarized or unpolarized light. Under unpolarized light the silica particles appear to be stained with a blue dye with a tinge of red, while under polarized light the silica particles appear either predominantly blue or red. Since particles are indentified easily by their color in either case, they can be measured readily as to size and quantity.

♦ ♦ ♦

NEW AIR-DRYING plastic protective coating has been developed by United States Rubber Co., New York, for application on steel, aluminum, concrete, hardwood or composition board for protection against attack from corrosive chemicals, atmospheres, weathering and rust. It cannot be used in food processing because it imparts a slight odor and taste. It is claimed that the plastic combines high flexibility with good adhesion and impact resistance, and will not chip or crack. It is applied by spray, allowing one hour drying time between coats, and 24-hr drying time after final coat. It requires no primer, and damage to the coating can be repaired by touching up.

♦ ♦ ♦

NEW USE for air-acetylene equipment, such as employed for burning off paint, has been found by a large midwestern foundry, according to the April issue of *Linde Tips.* Application is for drying paste after the cores are joined, and also for drying blacking applied. Paint burning head or fishtail burner is used for the operations, and it is said that the drying is accomplished easily and rapidly. The same type of equipment also is employed for skin drying molds where required.

♦ ♦ ♦

APPLICATION of oil purifiers in the quenching system employed in "marquenching" of gears and other parts at Fort Wayne, Ind. plant of International Harvester Co., for removal of dirt and products of oxidation, is claimed to triple the life of the quenching oil. They also enable the oil to drain more readily from the parts after quenching which results is lower oil consumption and reduction in cost of cleaning the parts after quenching. Oil purifiers were supplied by Honan-Crane Corp., Lebanon, Ind.

♦ ♦ ♦

IMPROVED method for handling rails used to hold down big molds in Allis-Chalmers No. 1 foundry has been devised by E. T. Nuetzel, a blacksmith. Previously sling ropes were used to lift the rails by overhead crane. The device suggested by Nuetzel, as demonstrated in the accompanying illustration, consists of a two-pronged hook which cradles the end of the rail. This is considerably safer than the old method.

♦ ♦ ♦

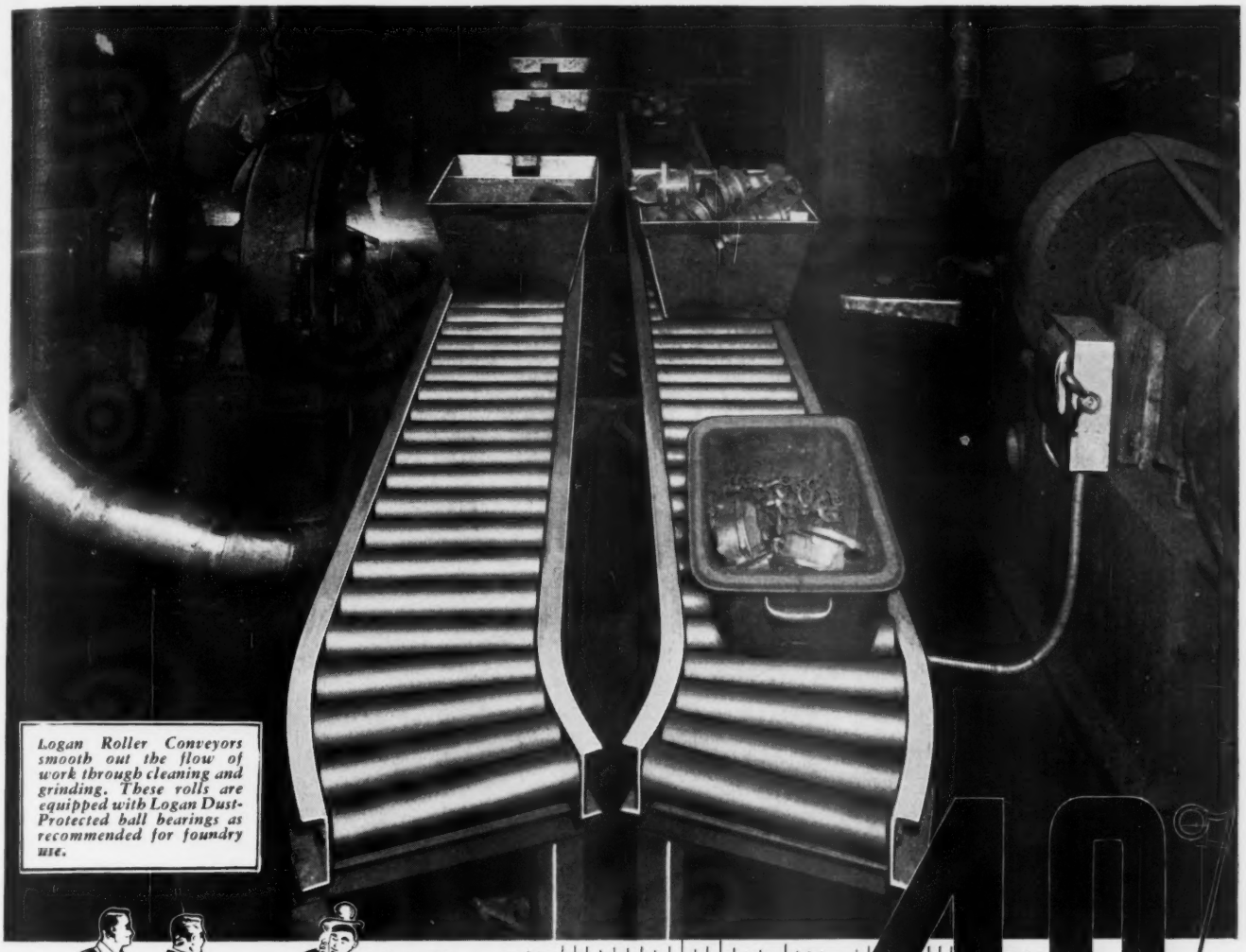
PILOT PLANT work by Baumer and Hulme on use of calcium carbide as a desulphurizing agent for gray iron indicates that it has considerable possibilities, particularly when low sulphur levels are desired. Some of their conclusions presented in the April issue of the *Journal of Metals* include: When properly applied calcium carbide can extract better than 90 per cent of the sulphur content. About 10 to 12 lb is required per pound S removed. Efficiency appears to be independent of S level in metal and of metal temperature, at least in the range 2550 to 2850° F. Cost ranges from $0.75 to $2 per ton of metal treated, depending on quantity of S to be removed. Sulphur levels in 0.01 to 0.02 per cent range and lower are attainable even when starting S is as high as 0.200 per cent. When S level in 0.06 to 0.08 per cent range is satisfactory in treated iron, process is not competitive with conventional treatments on a straight cost basis. Below this range it appears to offer real possibilities.

♦ ♦ ♦

DISCUSSING the effects of chromium and silicon on annealing of malleable iron at the recent AFS annual meeting, J. E. Rehder pointed out that as a practical rule, assuming approximately 2.5 per cent C and 1.1 to 1.5 per cent Si, the effect on first stage annealing rate of each increase of 0.01 per cent Cr can be compensated by increasing annealing time by 10 per cent, or increasing the annealing temperature by 10° F, or by increasing the Si by 0.05 per cent.

♦ ♦ ♦

NEWLY developed constant-pressure lathe for accurately determining the machinability of metals was described by Francis W. Boulger, Battelle Memorial Institute, Columbus, O., at the recent annual meeting of the American Society of Tool Engineers. Lathe operates with a constant pressure supplied by a weight-pulley system feeding the tool into the work. As the carriage moves, a cable pulling the carriage rings a bell at every 0.002-in. of travel; when the bell rings the operator records the number of revolutions the spindle has made. Feed is claimed to be a more sensitive indicator of machinability than tool pressure. Test results agree closely with other means of determining machinability, and with tool life actually observed in production runs.



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Activities of Foundry

GROUPS

Southern California

THE effect of alloying elements on copper-base alloys was discussed by E. V. Sumner, sales engineer, Federated Metals Division, American Smelting & Refining Co., Los Angeles, at the Apr. 13 meeting of Southern California Chapter of the AFS.

First Mr. Sumner traced the history of copper and discussed the development of the copper-base alloys. He explained phase diagrams and the information they portray. Thereafter, several slides were shown illustrating the effect of alloying metals, such as iron, phosphorus, beryllium, cadmium, aluminum, tin, nickel, arsenic, silver and zinc on properties of copper. In conclusion, the motion picture "Golden Horizons," which illustrated in color the history of copper and its alloys, was shown.

Present as an honored guest was Charles J. Hofschroer, a four-year apprentice at Kay-Brunner Steel Products Inc., Alhambra, Calif., whose pattern took first prize in both the local patternmaking contest and nationally at the recent AFS convention.

Instead of its regular dinner meeting in May, the chapter conducted a 3-session school on core blowing with the first two meetings held May 9 and 10 at Compton Foundry, Compton, Calif. James Barr, Compton Foundry, was chairman of the committee making arrangements for the school. Members of the committee were Lawrence Pridmore, International Molding Machine Co.; William Emmett, Los Angeles Steel Casting Co.; Paul Keonig, Mastercraft Pattern Co.; Leonard Hofstetter, Brumley-Donaldson Co.; and Ray Silva, Fairbanks, Morse & Co. Considerable interest was shown in the course with attendance averaging about 200 each night.

The first session was conducted by William Emmett who described and exhibited the various types of wood and metal core blowing boxes used in the foundry. During the second session, Lawrence Pridmore, Paul Keonig, and Ray Silva showed other types of boxes and described preferred methods of blowing and venting core boxes. Three core blowing machines were set up and several cores were blown using core boxes which had proved troublesome to some of the members.

At the final session Mr. Pridmore was the speaker. He exhibited various types of blow box accessories and explained their applications. He stated that the first thing to remember in blowing cores is that you must replace air with sand. Therefore, proper and sufficient vents are required. He said that it is wise to use as large a blow hole as possible since this minimizes the rifling action of sand and results in longer box life. He also discussed types of sand mixes.

Present at the final meeting was a group of students and their instructors to conclude a successful participation program developed by the chapter's education committee. E. K. Smith, chairman of that committee, and John Wilson, chapter chairman, presented cash prizes to John Schroeder, Los Angeles Trade-Technical College and Daniel R. Lucere, East Los Angeles Junior College, first and second prize winners in the chapter's essay contest.—*S. L. Jackson, Electro Metallurgical Co.*

SOUTHERN CALIFORNIA Chapter of the AFS held a successful school on core blowing May 9-11. Members of the arrangements committee for the school were, left to right: Paul Keonig, Mastercraft Pattern Co.; James Barr, Compton Foundry, committee chairman; Lawrence Pridmore, International Molding Machine Co., principal speaker at the concluding session; William Emmett, Los Angeles Steel Casting Co., and Ray Silva, Fairbanks, Morse & Co.

Twin City

FINAL meeting of the current season for Twin City Chapter of the AFS was held May 8 at the Covered Wagon, Minneapolis. Seventy members and guests were present to hear E. W. Haagensen, director of public relations, Allis-Chalmers Mfg. Co., West Allis, Wis., talk on "What Kind of a Salesman Are You."

After an opening of story telling which was received hilariously by the group, Mr. Haagensen dwelled on the subject of selling the American way of life to preserve the "proved best system of government ever devised" against the forces dedicated to our government's degradation and ultimate destruction. This job of selling was ramified to include the personal selling we all must do to succeed in our life endeavors.—*J. D. Johnson, Archer-Daniels-Midland Co.*

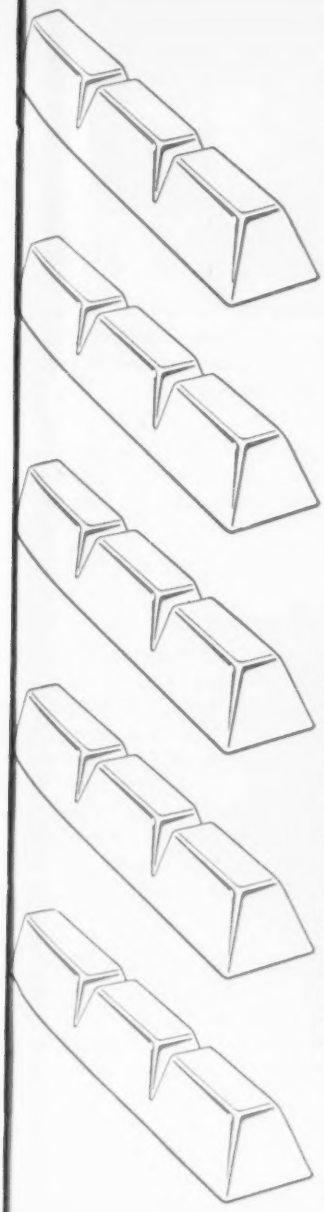
New Jersey

EDWARD Metzger, chief Castings Section, Office of Price Stabilization, Washington, addressed the May meeting of the New Jersey Foundrymen's Association, May 21, at the Military Park Hotel, Newark, N. J.

There was an unusually large attendance, including eleven foundrymen from the Philadelphia-Reading area and six from Connecticut.

It had been expected that casting price regulation would be issued before the meeting date and that Mr.

(*Continued on page* 164)



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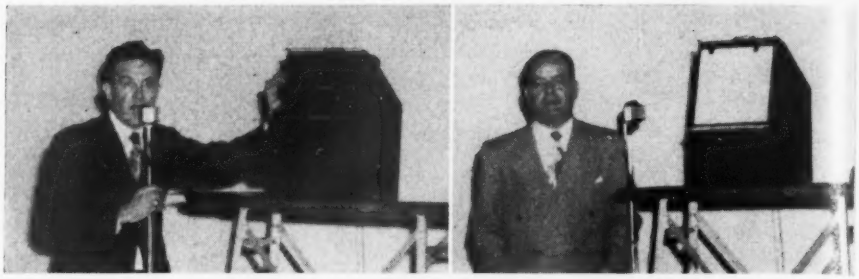
(*Continued from page* 162)

Metzger would be able to explain its term, but since it had not been issued Mr. Metzger was not authorized to disclose its provisions except to describe them in very general terms. He said he expected that it would follow the general pattern of CPR 30, but with certain changes to make it more appropriate for the foundry industry.—*Ben K. Price*



PHILADELPHIA Chapter of the AFS held its final meeting of the season at the Engineers Club, Philadelphia, May 11. At left is Daniel Talbot, Cooper Alloy Foundry Co., Hillside, N. J. and at right is Harold Ullrich, Sacks-Barlow Foundries Inc., Newark, N. J. speakers at the meeting

Conestoga

METAL shrinkage related to molding sand conditions was the topic of an illustrated talk by Clyde A. Sanders, vice president, American Colloid Co., Chicago, at the May 10 dinner meeting of Conestoga Foundrymen's Association held at Wiggins' Restaurant, Lancaster, Pa. Using gray iron as an example, Mr. Sanders showed that internal shrinks and piping could be influenced by sand conditions. If the mold materials are soft or weak, and moved during the pouring and cooling state, the resultant casting usually is oversize and shows internal shrinkage. This is more noticeable in bulky castings, or in a metal which passes through a mushy state before solidifying.

The following officers were elected at the business meeting: Chairman, W. T. Sheffield, Hershey Machine & Foundry Co.; vice chairman, Donald Smith, Riverside Foundry, Wrightsville, Pa.; treasurer, David M. Keener, Burnham Corp.; secretary, A. Gerhart Witte, Columbia Malleable Casting Corp. Directors of the association are: Thomas B. Belfield, Cochrane Foundry Inc.; J. Maurice Smith, New Holland Brass & Aluminum Co.; Gerrard L. Smith, York Corp.; Alfred C. Flury, Flury Foundry Co.; Thomas M. Blank, Carbon Malleable Casting Co.; C. O. Williamsen, Columbia Malleable Castings Corp., and John W. Mentzer, with Henry M. Yeager as alternate.

It was announced that the association would hold its annual picnic at the Overlook Gulf Club on July 28. —*M. E. Mohr, Hershey Machine & Foundry Co.*

Tennessee

CORE Making and Core Blowing" was the subject discussed by Zigmund Madacey, Caterpillar Tractor Co., Peoria, Ill., at the Apr. 27 meeting of Tennessee Chapter of the AFS.

Mr. Madacey stated that cores made in one piece cause less trouble than those produced by hand ramming in

(*Continued on page* 167)

CHICAGO Chapter of the AFS held roundtable sessions Mar. 5 at the Chicago Bar Association. In Fig. 1, Harry A. Kessler, Sorbo Mat Process Engineers, St. Louis, discussed gates and risers at the gray iron session. Fig. 2—C. A. Faist, Burnside Steel Foundry Co., Chicago, presented production problems on metallurgical control at the steel session. Malleable and pattern divisions held a joint session at which a panel (Fig. 3) discussed foundry headaches caused by pattern design and construction. Left to right are: Joseph Pudlek, Illinois Malleable Iron Co.; W. L. Andriese, Chicago Malleable Castings Co.; Charles C. Sassetti, National Malleable & Steel Castings Co.; H. K. Swanson, Swanson Pattern & Model Works; F. J. Dengler, Crane Co.; Jim Sinita, Inland Steel Co., and George Skupa, International Harvester Co. Photos by I. H. Dennen, Beardsley & Piper Division, Pettibone Mulliken Corp., Chicago

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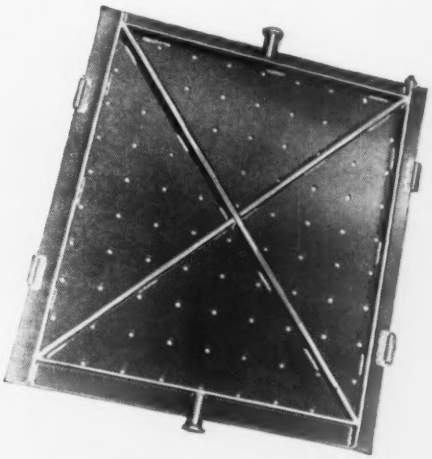

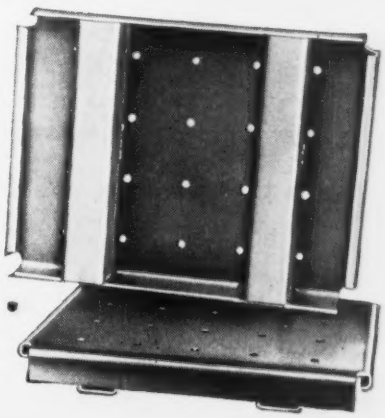

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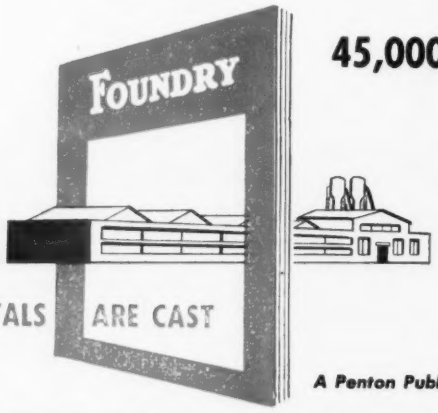

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(*Continued from page* 164)

halves, pasting, etc. Blowing cores with close tolerances is possible with good coreboxes properly vented and it isn't necessary to have large production to blow cores economically.

The speaker urged foundrymen to concentrate their efforts on making quality castings before considering production problems since he has found that by designing and making a quality product, many of the bothersome production problems iron themselves out. Mr. Madacey pointed out there is a proper ratio between vents and blow holes that must be maintained for good core blowing. Practice is about the only way to find out how much green bond is needed for stand-up cores in blowing. Wooden core boxes may be used if they are armored with metal at weak points. He pointed out that vents at joints generally cause trouble.

Election of officers for the coming year was held by Tennessee Chapter of the AFS at its May 25 meeting held at Hotel Patten, Chattanooga. Porter Warner, Porter Warner Industries, was elected chairman; W. M. Hamilton, Crane Co., Chattanooga, was named vice chairman; and Richard Kirchmayer, Sterling Wheelbarrow Co., is secretary-treasurer. Newly elected directors to serve three years are Charles Saunders, Tennessee Products Co., and Howard B. Wilson, Somerville Iron Works. Retiring chairman Paul L. Arnold and secretary-treasurer Herman Bohr, will continue to serve the chapter as directors for one year.

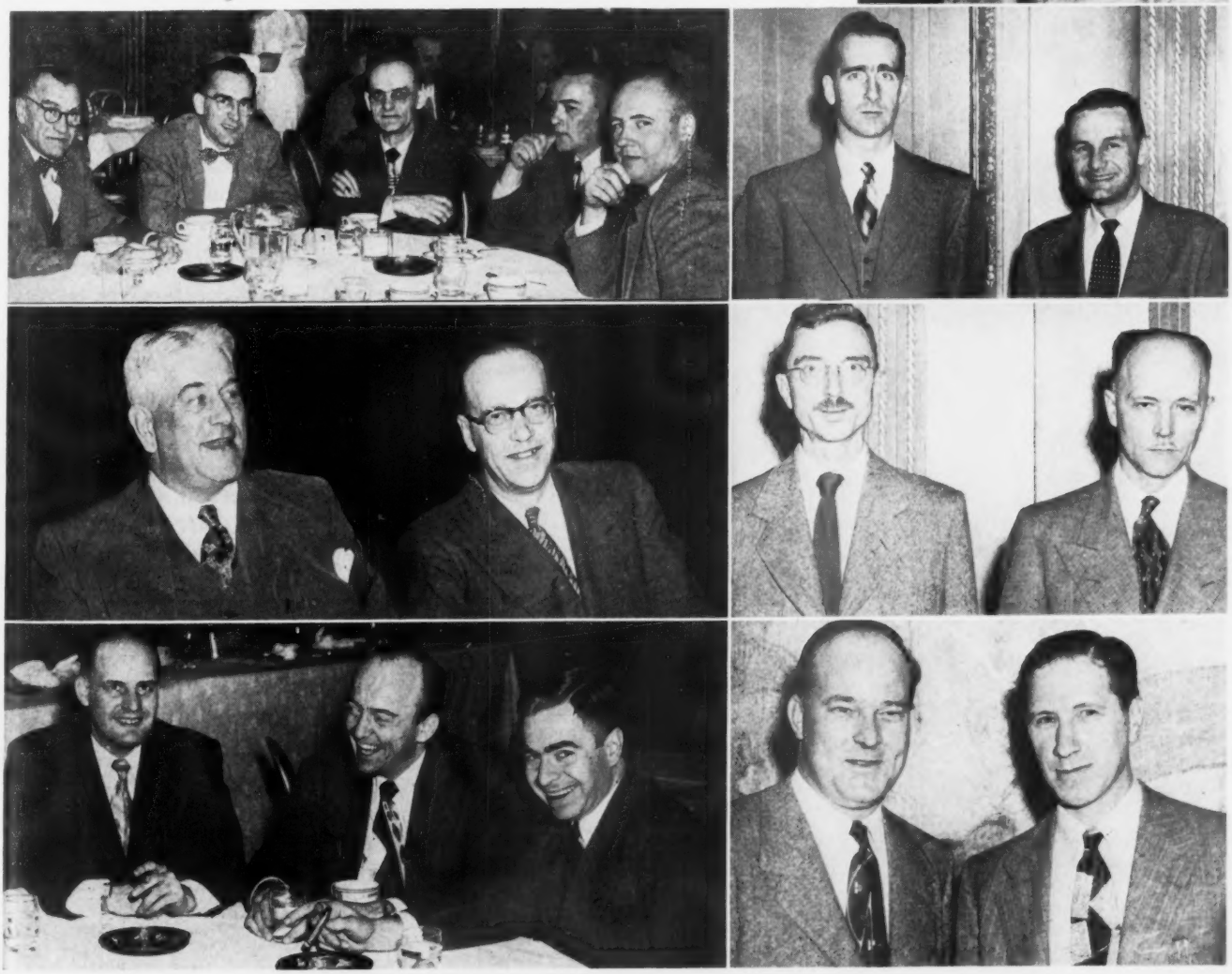
Retiring Chairman Arnold reported on progress made by the chapter during the past year and newly-elected Chairman Warner appointed the following to serve as a committee to arrange the chapter's annual barbecue which is to be held in August: Ed Williams, chairman, Burt Mullinex, Fred H. McGee, Harvey Jarnigan and Richard Kirchmayer.

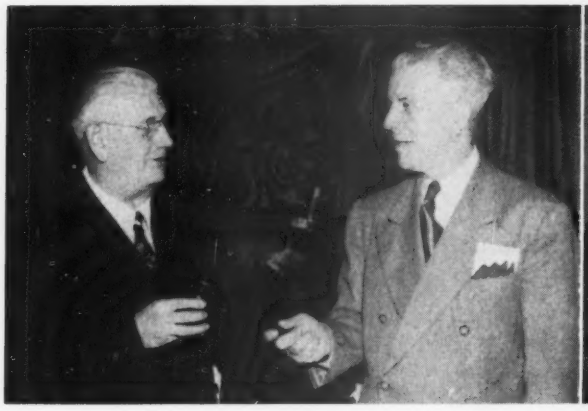
The meeting was concluded with a quiz program on "Casting Defects." The following received the highest grade: J. D. Martin and Arden Imm, Combustion Engineering Co. Inc.; Don Andrews, Mueller Corp.; Charles Chisholm, Wheland Co.; Paul Stuff, Albert Waller and David L'Heureux, Ross-Meehan Foundries Inc. There were not enough prizes to go around so names were drawn for the prizes and the remainder received tickets to the chapter's barbecue. — *Carl A. Fischer Jr., Fischer Supply Co.*

Northeastern Ohio

NORTHEASTERN Ohio Chapter of the AFS honored old timers and apprentices at its regular meeting Apr. 12, Tudor Arms Hotel, Cleveland. Approximately 150 foundrymen with 40 or more years of

WISCONSIN Chapter of the AFS held sectional sessions at its Apr. 13 meeting. Views of speakers and others at the meeting are shown. Photos by courtesy of Walter V. Napp., Badger Firebrick and Supply Co.





METROPOLITAN Chapter of the AFS held its final technical meeting of the season May 7 at the Essex House, Newark, N. J. Shown at left, left to right, are D. S. Yeomans, George F. Pettinos Inc., East Orange, N. J., retiring chairman turning over the gavel to D. Frank O'Connor, O'Connor's Foundry Inc., Hackettstown, N. J., 1951-52 chairman. At right, left to right, are chapter apprentice contest winners: Stephen Matviyetz and Salvatore Alfiere, Cooper Alloy Foundry Co., Hillside, N. J., first place in wood patternmaking and steel casting, respectively, and Joseph Ramaglia, Atlas Foundry Co., Irvington, N. J., first place, gray iron casting. Photos by John Bing, Metropolitan Refractories Corp.

service to the industry received certificates acclaiming their work record. Total attendance was 337.

Apprentice winners in the local contest were announced and received prizes of $25, $15, and $10 for first, second, and third place in each division. Molding division winner was Donald Hinman, Hill Acme Co. Michael E. Sedlak, Hill Acme Co., was second, and Donald Marinelli, Fulton Foundry & Machine Co., was third.

In wood patternmaking, first prize went to Fred Fiorentini, Modern Pattern Co., second to Donald A. Siebert, Royal Pattern Works, and third to Eugene Chmielowicz, Motor Patterns Co. James Gaino, Royal Pattern Works, was the only entrant in metal patternmaking and his work was deemed worthy of first prize in that division.

Chapter officers and directors were nominated for the coming year. They are: President—Gilbert J. Nock, Nock Fire Brick Co.; vice president—Frank C. Cech, Cleveland Trade School; secretary, R. D. Walter, Archer-Daniels-Midland Co., and treasurer—F. Ray Fleig, Smith Facing & Supply Co.

Directors for three years are: Harold Strater, North American Refractories Co.; Walter Quayle, National Malleable & Steel Castings Co.; Alexander D. Barczak, Superior Foundry Inc.; George Clifford, Fulton Foundry & Machine Co., and George E.

(*Continued on page* 171)

WESTERN NEW YORK Chapter of the AFS met at Hotel Sheraton, Buffalo, Apr. 6 to hear J. A. Ridderhof, Frederic B. Stevens Inc., speak on "Core and Mold Coatings." Shown below at the speakers' table, left to right, are: Max Ganzauge, General Railway Signal Co., Rochester, N. Y.; Robert Young, Lumen Bearing Co., Buffalo; Marve Taublieb, Frederic B. Stevens Inc., Buffalo; Dr. Ridderhof; Erwin Deutschlander, Worthington Pump & Machinery Corp., Buffalo; A. A. Diebold, Atlas Steel Casting Co., Buffalo, chapter chairman; Roger Walsh, Hickman, Williams & Co., Buffalo, and Martin J. O'Brien Jr., Symington-Gould Corp., Depew, N. Y. Local winners in the AFS apprentice contest are shown at left. They are: Wood pattern division—Gene Busch and Robert Gross, Worthington Pump & Machinery Corp., first and second, respectively. Ferrous division—Casimer F. Ogledzinski, Symington-Gould Corp., first, and Philip Schneider, Standard Buffalo Foundry, second. Nonferrous division—John Klym and Carlton Metzloff, Lakeside Bronze Inc., first and second, respectively. Photos by Marve Taublieb, Frederic B. Stevens Inc.

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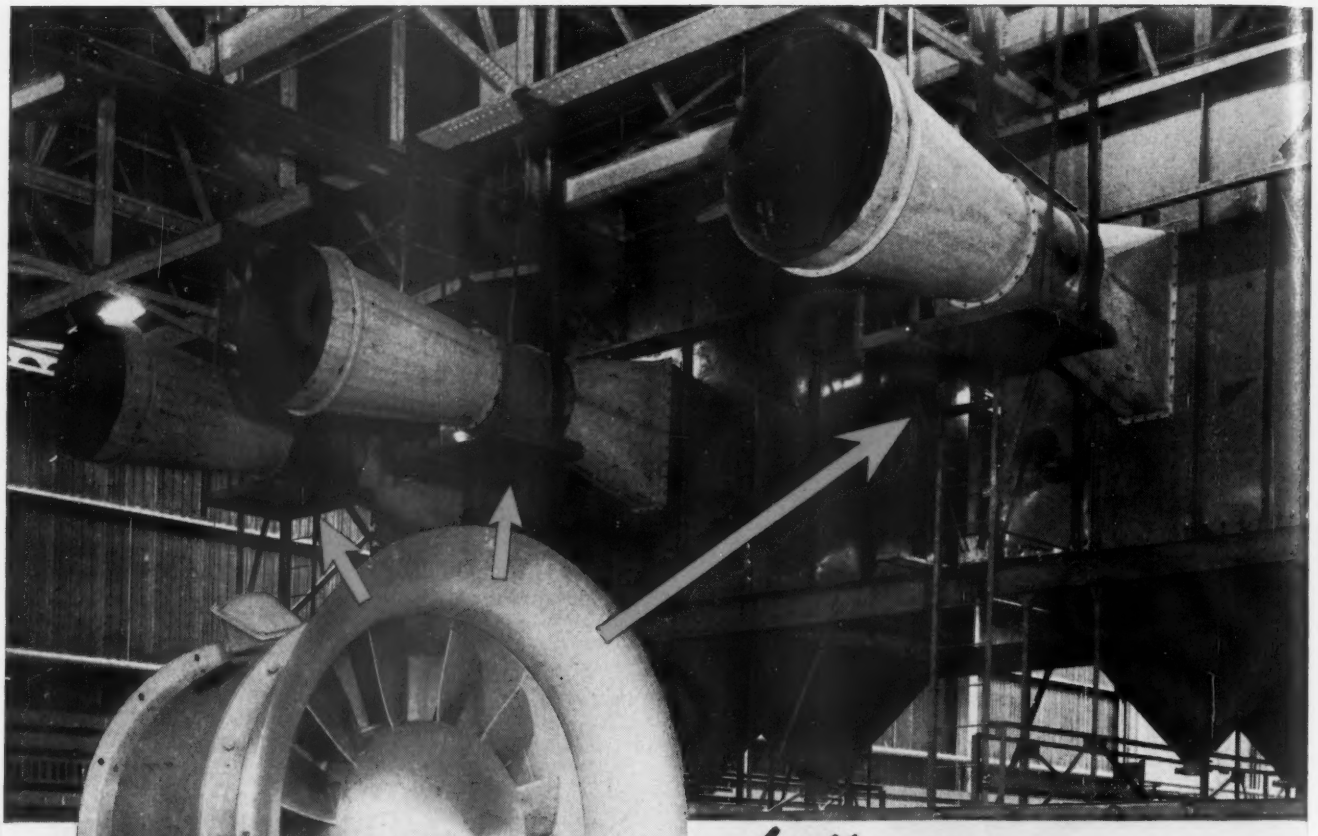

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(*Continued from page* 168)

Miller, Osborn Mfg. Co.

Frank G. Steinebach, Editor, FOUNDRY, spoke at the May 24 meeting of the chapter. In his talk, "What's Ahead," Mr. Steinebach discussed current Washington developments relating to the foundry industry. He pointed to the government's realization that castings are basic to industry—a lesson learned from World War II. Consequently, foundries are getting a better break in industry regulations associated with current defense preparations.

He also spoke of the fine co-operation among foundry industry societies in presenting their problems to Washington agencies and stressed the importance of even greater co-operation. He stated that the foundry advisory committees are the second best organized group of the Munitions Board.

This meeting also honored past chapter presidents and national officers. Walter L. Seelbach, Superior Foundry Inc., Cleveland, and national AFS president-elect, gave a brief talk.

Chapter officers and directors nominated at the April meeting were elected to office.—*Robert H. Herrmann*

Philadelphia

AT the Apr. 13 meeting of Philadelphia Chapter of the AFS, held at the Engineers' Club, Philadelphia, Douglas James, foundry superintendent, Cooper-Bessemer Co., Grove City, Pa., discussed "Nodular Iron." There were 125 members and guests present.

Mr. James described the problems which Cooper-Bessemer encountered in setting up cupola and molding techniques so that standards set up by the engineering staff could be reproduced. They have found best castings are produced in dry sand molds. Pinhole porosity has been encountered when metal has been poured in green sand molds and so far that problem has not been solved. It has been found when chemical analysis is within certain ranges the metal would be nodular when heat treated.—*G. H. Bradshaw, Philadelphia Naval Shipyard*

Metropolitan

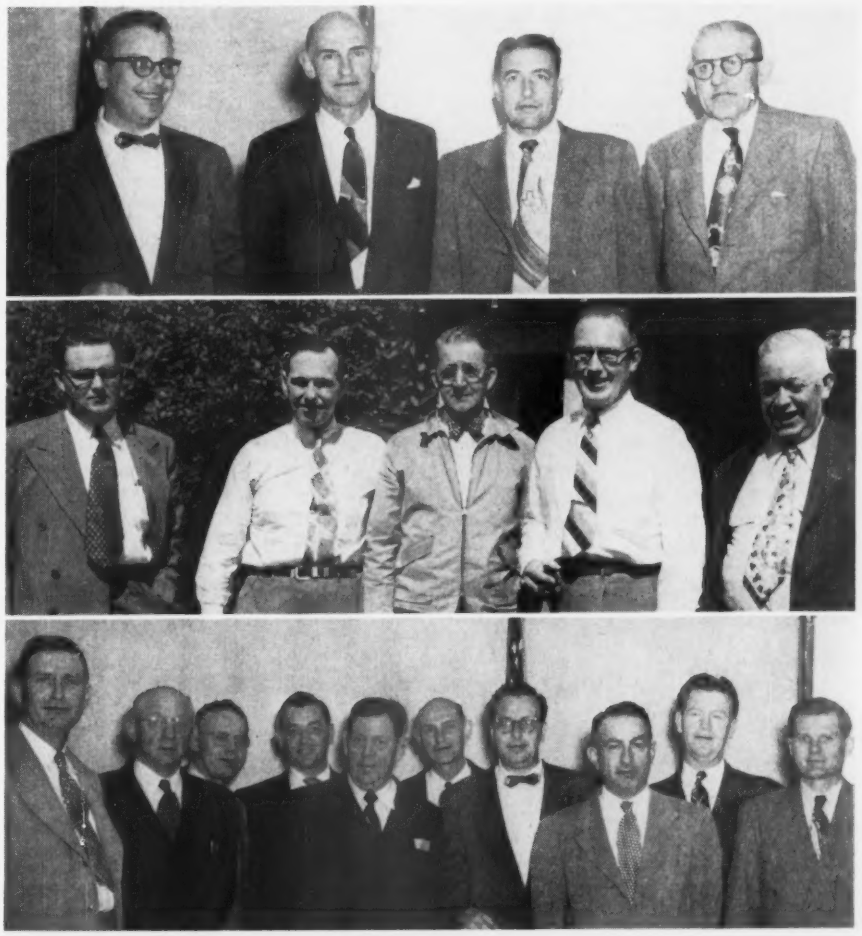
A TALK on "Sand Control" by Earl E. Woodliff, sand consultant, Detroit, was featured at the Apr. 2 meeting of Metropolitan Chapter of AFS held at Essex House, Newark, N. J. There were 112 members and guests present.

Mr. Woodliff stated that sand and cores are responsible for a major part of the foundry's scrap. He stressed the need for more sand control and less sand testing.

The speaker said that most binders retain their own individual characteristics when mixed with sand; thus a molding or core sand can be predicted. He recommended keeping the clay content of molding sands between 9 and 14 per cent.

Mr. Woodliff advocated a widespread grain distribution and recommended blending two or more sands to achieve a 4 to 6 screen spread in preference to a 2 to 3 screen spread. He emphasized density as an important factor in reducing scabs, buckles

EASTERN NEW YORK: Last chapter meeting of the season held May 15 featured a roundtable discussion led by Howard Nye, Crompton Knowles Loom Works, Worcester, Mass., center. Left to right in the photo are: Leo Scully, Scully Foundry & Machine Co., Coxsackie, N. Y., Eastern New York Chapter chairman; Mr. Nye, and D. S. Yeomans, George F. Pettinos Inc., Metropolitan Chapter chairman. Photo by Leigh M. Townley, Adirondack Foundries & Steel



TEXAS Chapter of the AFS held its annual spring meeting at Lufkin, Tex., Apr. 13. Visitations were made during the day to Texas Foundries and Lufkin Foundry & Machine Co. A banquet was held at Angelina Hotel in the evening with Bruce L. Simpson, president, National Engineering Corp., as guest speaker. Top photo, left to right, are: W. H. Lyne III, Hughes Tool Co., chapter chairman, and Past Chairmen C. R. McGrail, Jake Dee, and F. M. Wittlinger. At center is a social group. The chapter's board of directors is shown at bottom

CENTRAL OHIO Chapter of the AFS held sectional sessions at its Apr. 9 meeting. D. E. Krause, Gray Iron Research Institute, Columbus, O., spoke on "Cupola Practice." Fitz Coghlin Jr., Albion Malleable Iron Co., Albion, Mich., discussed "Various Phases of Manufacturing Control," and R. A. Willey, Commercial Steel Casting Co., Marion, O., descibed "Recent Developments in Weld Repair of Steel Castings." Photo by Wilfred White, Jackson Iron & Steel Co.

and metal penetration, and suggested weighing the standard permeability test specimen as a simple test for density.—*W. T. Bourke, American Brake Shoe Co.*

Quad City

A DIFFERENT method of presentation was used by A. L. Gardner, advertising manager, Pangborn Corp., Hagerstown, Md., in telling his story about airless cleaning at a recent meeting of Quad City Chapter of the AFS. His chalk illustrations aptly described cleaning room progress. Various types of cleaning equipment, both standard and special purpose, were discussed. In comparing air blast with centrifugal blast cleaning, Mr. Gardner pointed to the reduction in both horsepower and manpower required by the latter. Leonard Wagner, Chicago district represensative of Pangborn Corp., took over the meeting following Mr. Gardner to answer technical questions.

Prior to the technical session, Colonel Warner, commandant of the Rock Island Arsenal, Rock Island, Ill., talked about the arsenal's effect on the community.

The nominating committee presented the following 1951-52 slate of officers: Chairman, W. C. Bell, Frank Foundries Corp., Moline, Ill.; vice chairman, E. C. Zirzow, Deere & Co., Moline, Ill.; secretary-treasurer, R. E. Miller, John Deere Planter Works, Moline, Ill. Directors nominated for three-year terms: C. C. Fye, C. S. Humphrey, and R. P. Ray.—*Robert E. Miller, John Deere Planter Works*

Birmingham

ALMOST 100 foundrymen attended the May 18 meeting of Birmingham District Chapter of the AFS which featured the chapter's annual "Quiz Program." Quiz master T. H. Benners presided and a corps of experts answered questions from the floor on any foundry subject. The experts and their respective fields were: W. W. Austin, Southern Research Institute, nodular iron and machinability; Frank H. Coupland, American Cast Iron Pipe Co., foundry metallurgy; Ray L. Farrabee, Central Foundry Co., foundry metallurgy; Robert L. Jones, Pressure Cast Products Co., pressure castings; Fred E. Vann, Stockham Valves & Fittings, foundry engineering; W. Austin Langford, East Birmingham Bronze Co., nonferrous; H. E. Montgomery, Alabama Pattern Works, patterns; Hammond Wood, Alabama By-Products Corp., coke and cupola operations.

Annual election of officers also was held. The newly elected chairman is Charles K. Donoho, American Cast Iron Pipe Co.; vice chairman, Fred K. Brown, Adams Rowe & Norman Inc., and secretary-treasurer, John Drenning, Kerchner, Marshall & Co.—*J. P. McClendon, Stockham Valves & Fittings*

STUDENT VISITORS: Twenty-six members of Michigan State College Student Chapter of the AFS recently were guests of Engineering Castings Inc., Marshall, Mich., where they observed modern foundry production techniques in the manufacture of valve insert rings. Following luncheon at Schueler Hotel, Marshall, company officials answered questions and students discussed their impressions of the casting procedures. From right to left in front row of the photograph are: Fred J. Walls, company vice president; A. E. Rhoads, company president, and C. C. Sigerfoos, associate professor of mechanical engineering, Michigan State College

Central Illinois

A CONSIDERATION of "Core Room Problems" featured the May 7 meeting of Central Illinois Chapter of the AFS, held at the American Legion Home, Peoria, Ill. Warner Bishop, foundry sales manager of Archer-Daniels-Midland Co., Cleveland, was guest speaker.

Mr. Bishop pointed out that although foundrymen have attempted to use a great variety of materials for binding core sand, cereal, core oil, synthetic resin and water comprise 99 per cent of the materials now in use. He then enumerated the advantages and disadvantages of each of these materials and stated, "Proper ratios and mixing along with control of baking time and temperature are important in the production of a cheap, quality core." In the discussion which followed, Mr. Bishop endeavored to correct problems that the members had encountered. The meeting closed with the election of chapter officers and directors for the coming season.—*Robert J. Paluska, Caterpillar Tractor Co.*

Chesapeake

TWO films were presented, both accompanied by sound narration, at the May 25 meeting of Chesapeake Chapter of the AFS held at the Engineers Club, Baltimore.

William H. Johnson, Naval Research Laboratory, Washington, presented one entitled, "Step Gating," which is a sequel to "Gating Systems for Metal Castings." The film illustrated that optimum quiet and sequence feeding could be attained by the use of reversed sprue step gate designs which utilize momentum pressure traps to decrease the velocity of the incoming metal.

"Fluid Flow in Transparent Molds," Part 2, produced at Battelle Memorial Institute under the sponsorship of the Aluminum and Magnesium Division of AFS, also was presented.

At the meeting Allen Kittrell, Leach Pattern Shop, Baltimore, was elected chairman for the coming year.—*William H. Baer, Naval Research Laboratory.*

Advertisement

ELECTROMET Data Sheet

A Digest of the Production, Properties, and Uses of Steels and Other Metals

Published by Electro Metallurgical Company, a Division of Union Carbide and Carbon Corporation, 30 East 42nd Street, New York 17, N. Y. • In Canada: Electro Metallurgical Company of Canada, Limited, Welland, Ontario

How Manganese Briquets Control Sulphur . . . Produce Cleaner, Sounder Iron Castings

The use of manganese briquets in the cupola charge provides a convenient and accurate method of controlling this important element in cast iron. Accurate control of the manganese level is essential for the consistent production of high-quality iron. While manganese will be introduced in varying amounts by the pig iron and scrap, a supplementary source—such as manganese briquets—is usually essential if accurate analysis control is to be maintained.

Manganese has two important functions in cast iron:

1. It acts as a sulphur-neutralizing element when used in small amounts — up to roughly six times the sulphur content.
2. It acts as an alloying element, imparting density and strength when present in amounts greater than necessary to perform its desulphurizing function.

Neutralizes Sulphur

Cast iron tends to run considerably higher in sulphur than was the case a decade ago because there has been an increase in the sulphur content of both scrap and foundry coke in recent years. Unless sufficient manganese is provided in the cupola mixture, this higher sulphur content will tend to produce a hard, brittle metal with deep chilling properties and poor fluidity. Castings of such metal are difficult to machine and may be the cause of many foundry troubles, including strain cracking, chilled corners and edges, and misrun castings.

Since manganese has a high affinity for sulphur, it forms manganese-sulphide inclusions when present in sufficient amounts. These inclusions are relatively harmless to the metal, and the detrimental effects of the sulphur content are thus largely eliminated. It is good practice to maintain a manganese-sulphur ratio of approximately 6:1 to insure proper neutralization of the sulphur content.

A certain proportion of the manganese-sulphide that is formed will float to the surface of the molten iron and be absorbed by the cupola slag. In this way, manganese actually eliminates a portion of the sulphur introduced by cupola melting. Thus, relatively high manganese irons will invariably run lower in sulphur than will metal melted from similar raw materials but of lower manganese content.

Sounder Castings

The cleansing effect of manganese is a decided help in producing a high-quality foundry product with a minimum amount of trouble from porosity, shrinks, and blows. Manganese helps to neutralize gassy metal that may result from temporarily unbalanced cupola conditions or poor-quality melting materials. It improves the fluidity of iron that may be a little on the cold side or high in sulphur. Manganese does a general cleansing job that is helpful in avoiding slag inclusions, which have a detrimental effect on machinability.

Alloy Effects

When manganese is used in amounts greater than that necessary to neutralize sulphur, it acts as a desirable carbide-stabilizing alloy in cast iron. Depending on the amount added and other elements present, manganese tends to refine pearlite and, at higher levels, to form martensite. Increasing the normal percentage of manganese in cast iron to 1 per cent or above will often change a normally ferritic-pearlite matrix to the stronger all-pearlitic structure.

Two Types of Briquets

ELECTROMET produces two types of manganese briquets — EM silicomanganese briquets and EM ferromanganese briquets. The silicomanganese type is square in shape and contains exactly 2 lb. of manganese and about ½ lb. of silicon. Ferromanganese briquets, which are oblong in shape, also contain exactly 2 lb. of manganese, but do not contain silicon.

The recovery of manganese from EM manganese briquets normally runs about 85 per cent, because the briquets are made with a binder that prevents oxidation until the alloy unites with the iron in the melting zone of the cupola.

A typical mixture for high-strength iron is given in the accompanying table. For further information—

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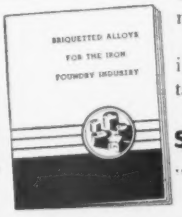
Typical Cupola Charge for Producing High-Strength Iron With EM Briquets

Base Charge			Alloys in Charge Material			
			Silicon		Manganese	
%	Lb.	Material Charged	%	Lb.	%	Lb.
15.0	150	Pig Iron	2.30	3.45	0.70	1.05
40.0	400	Steel Scrap	0.10	0.40	0.45	1.80
35.0	350	Return Scrap	1.90	6.65	1.00	3.50
10.0	100	Purchase Scrap	2.00	2.00	0.45	0.45
100.0%	1,000 lb.	Total Base Charge		12.50		6.80
Briquets Required		7½ Small Silicon		7.50		—
		2½ Silicomanganese		1.25		5.00
		Total Alloys Charged		21.25 lb. Si. or 2.12% Si.		11.80 lb. Mn. or 1.18% Mn.
		Melting Recovery Factor		x .90		x .85
		Final Analysis of Iron		1.90% Si.		1.00% Mn.



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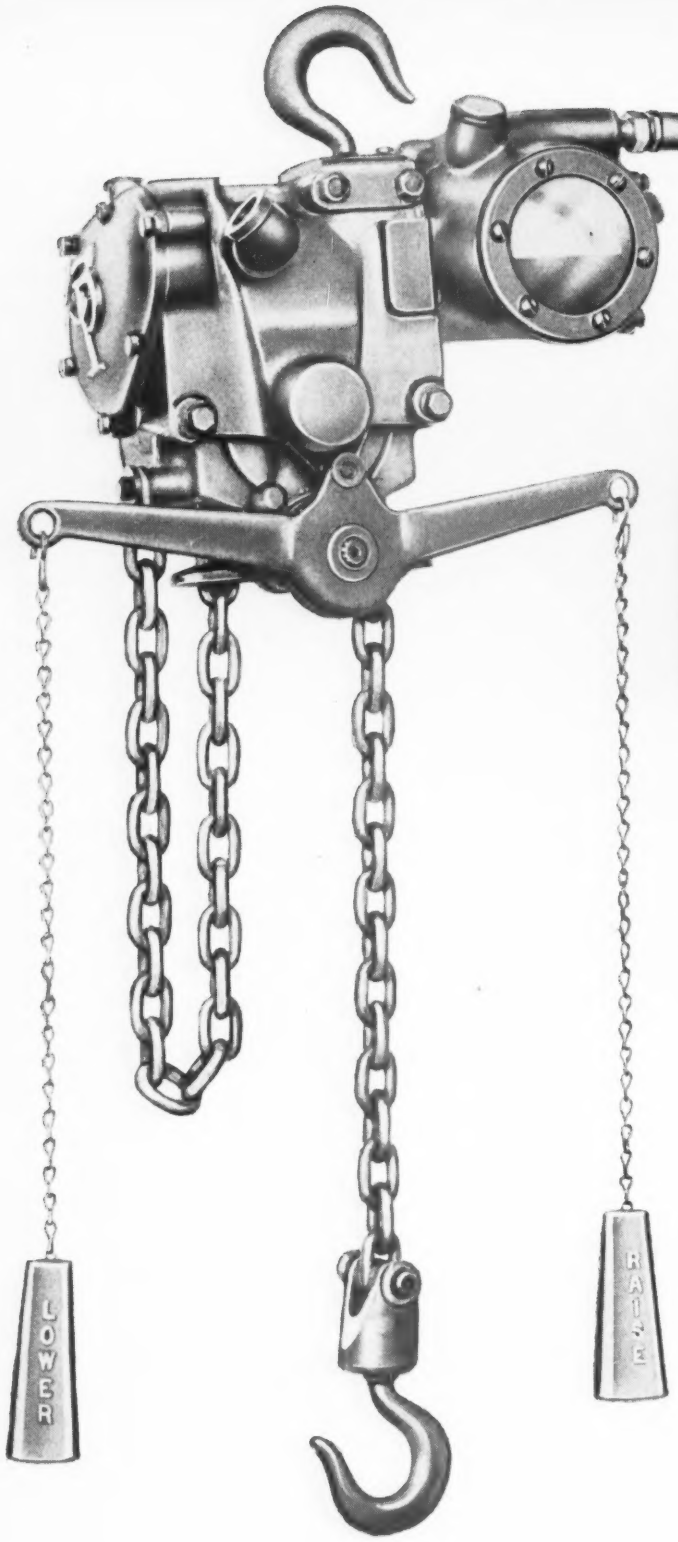

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Manganese and Its Effect on Iron

ABC of Foundry Practice

THE element manganese does not occur free in nature but commonly is found in combination with oxygen and iron in iron ores. Practically all iron ores contain manganese, and the percentage present in the ore will determine the percentage in the pig iron made from that ore.

The most common forms of manganese utilized by the iron foundrymen are pig iron, ferromanganese, spiegeleisen and manganese briquets. The standard grade of ferromanganese contains about 80 per cent manganese and 6.75 per cent carbon. The standard grade of spiegeleisen contains about 20 per cent manganese. Manganese briquets contain 2 pounds of manganese and ½-pound of silicon.

Manganese is an unusual element in ferrous metallurgy, since it serves both as a scavenger and as an alloying element. It combines readily with carbon, oxygen and sulphur. In steelmaking it is classified as a "deoxidizer" and as a "desulphurizer" and it is the important alloy in the 12 to 14 per cent austenitic manganese steel.

Maintain Manganese-Sulphur Balance

In malleable iron, its affinity for sulphur is utilized by the foundryman to achieve a balance between manganese and sulphur so that the iron will anneal with high ductility. In this manganese-sulphur balance, manganese is twice the sulphur content plus 0.15 per cent; that is, with 0.1 per cent sulphur, manganese is about 0.35 per cent. When manganese is used in greater amounts in malleable iron it is being used as an alloying element.

The least harmful form of sulphur in cast iron is as manganese sulphide and this is the more important function of manganese in cast iron. Manganese sulphide is lighter than cast iron, and in the cupola has a tendency to rise and combine with the slag and thus separate out. The formation of this compound and its rising through the molten metal takes some time. This desulphurization is not complete, no matter how long the iron is held, for some of the manganese tends to combine with carbon before all of the sulphur has been absorbed by it.

As manganese is easily oxidized, cupola melting losses are generally close to 20 per cent; thus if 0.60 per cent manganese is desired in the castings, the cupola charge must contain about 0.75 per cent manganese. The chemistry of various types of cast iron varies from 0.5 to 1.5 per cent manganese but is normally close to 0.7 per cent.

The refractories normally used as cupola furnace linings are known as "acid" refractories as they react chemically like "acids" at high temperatures. When manganese combines with oxygen, manganese oxide is formed and at high temperatures this reacts as a "base." In chemistry, acids and bases react, and sometimes very violently, to form other compounds. In a similar way manganese oxide reacts with cupola furnace linings to impose a rather modest use of manganese in iron foundry practice.

Core Sands

THE important properties of cores are: (a) dry strength; (b) permeability; (c) smoothness of surface; (d) moisture resistance; (e) heat resistance; and (f) friability.

Dry strength determines the fragility or ruggedness of the finished core and its ability to stand rough handling between the oven and the mold, and to support loads in the mold. Permeability is necessary because cores are sometimes almost entirely surrounded with metal; and, while little if any water vapor is formed in dry cores, gas from burning core binders and other mold gases must be permitted to escape. Core surface is important because it is a major factor in forming smooth castings.

When cores are allowed to remain in storage for long periods, at room temperature, or lie in damp molds for considerable time, they should not absorb moisture and become soft. Cores must resist the fusing action of molten metal, otherwise they *burn on* to the castings or allow the metal to bite into the surface. In either case, rough castings result. Though cores should be resistant to fusion, it frequently is required that they be friable after the casting has been poured; that is, they must be broken up easily and removed from the casting.

The green core sand mixture also has certain properties on which its workability depends. The most important of these are green strength, plasticity, stickiness, and rate of drying. Sands of high green strength are required for making cores of intricate design, and supporting and handling them without special equipment such as dryers. All these properties are determined by the selection of sands and binders and the proportions and manner in which they are mixed.

High-silica sands of low or no clay content are usually used as the base of core sand mixtures. They are highly resistant to heat, open, and of low green bond. The Ottawa sands are the cleanest and most refractory of these, but dune or lake sand from the shores of the Great Lakes, such as Michigan City sand, and shore sand from the Atlantic coast are more widely used. Low-clay bank sands of grain fineness 60 to 100 are also used extensively. Molding sand, foundry floor sweepings and silica flour are used to impart green bond and fine texture. Sands of high colloidal content supply good green bond but require much oil to bind them. Silica flour, though finely ground, is not colloidal.

Several Types of Binders

Four general types of core binders used are: (a) Oils; (b) water soluble binders such as sulphite, casein, molasses; (c) resins, and (d) cereals such as corn and wheat flour, dextrine. Drying and semi-drying oils such as linseed, rapeseed, soy bean, and corn oil becomes hard under heat due to oxidation rather than the loss of moisture, so air must be supplied to oil-bonded cores in baking. Non-drying oils such as kerosene, fuel oil and paraffin oil are evaporated almost entirely in the baking process and so have no bonding value. They are used to dilute oil binders and to prevent sands from sticking to core-boxes.

Water soluble binders such as flour, dextrin, sulphite, etc. are cheaper than oils and afford more green bond. They become hard upon losing moisture but readily absorb moisture and become soft after standing a time in a green mold. Resin binders such as rosin, pitch, urea-formaldehyde resin, petroleum resin, etc. become soft upon

heating, stick to the grains of sand, and become hard again upon cooling. Cores made with such binders are soft while hot and yield readily with the casting as the metal shrinks.

All organic binders are broken down at temperatures under those of molten metal resulting in cores that are removed easily. Clay, portland cement, and similar mineral binders are good bonding materials, but become very hard or at least fail to break down when the castings are poured, so difficulty may be encountered in cleaning the castings.

Aside from hand, shovel, and riddle methods of mixing used in small foundries, two types of power mixers are in general use. They are the blade and muller types.

(To be concluded next month)

Executive Sales Staff Revised by American Wheelabrator

AMERICAN Wheelabrator & Equipment Corp., Mishawaka, Ind., associated with the foundry industry since 1908, is reorganizing and expanding its sales staff at the executive level, effective July 1, according to Otto A. Pfaff, president. The move is intended to meet expanding use of the company's products in both foundries and general industry.

L. L. Andrus, formerly vice president in charge of sales, is promoted to vice president and executive head of the Dust & Fume Division. John A. Silver has been appointed director of sales. He was formerly a partner in the firm of Lester & Silver, management and sales consultants of New York and Philadelphia. E. B. Rich, Chicago regional manager of the company, becomes general sales manager. A. E. Lenhard, advertising and sales promotion manager, assumes new responsibilities. S. S. Deputy, sales manager, will work closely with the general sales manager on special assignments. He will also coordinate sales and production, and handle customer services. Bernard Lester, of Lester & Silver, will continue as a sales management consultant to the sales division and to general management.

JOHN A. SILVER

L. L. Andrus, a mechanical engineering graduate of Purdue University, was associated with a Chicago firm of consulting engineers before joining American Wheelabrator in 1934. He is well known in the foundry and chemical processing industries and is a member of the American Foundrymen's Society and the American Society for Metals.

John A. Silver has had 23 years' experience in engineering management. For many years he was executive vice president of the F. J. Stokes Machine Co., Philadelphia, manufacturer of pharmaceutical, chemical processing and special equipment. He is well known in these fields as well as those of plastics, powdered metals, and high vacuum applications. He is a member of the American Society of Mechanical Engineers, the American Management Association, and the National Industrial Advertisers Association.

E. B. Rich, an alumnus of Dartmouth, Northwestern University, and Armour Institute of Technology, started in 1934 in the company's foundry. He was shifted to Chicago as sales and service engineer, and rose to district manager in 1945. Mr. Rich frequently has acted as consultant on plant layout problems. He is a member of the American Foundrymen's Society.

A. E. Lenhard, advertising and sales promotion manager of the company since 1936, has been made responsible for market research and special work in sales development, working closely with the director of sales. He is a member of the National Industrial Advertisers Association and is a graduate of the University of Notre Dame.

L. L. ANDRUS

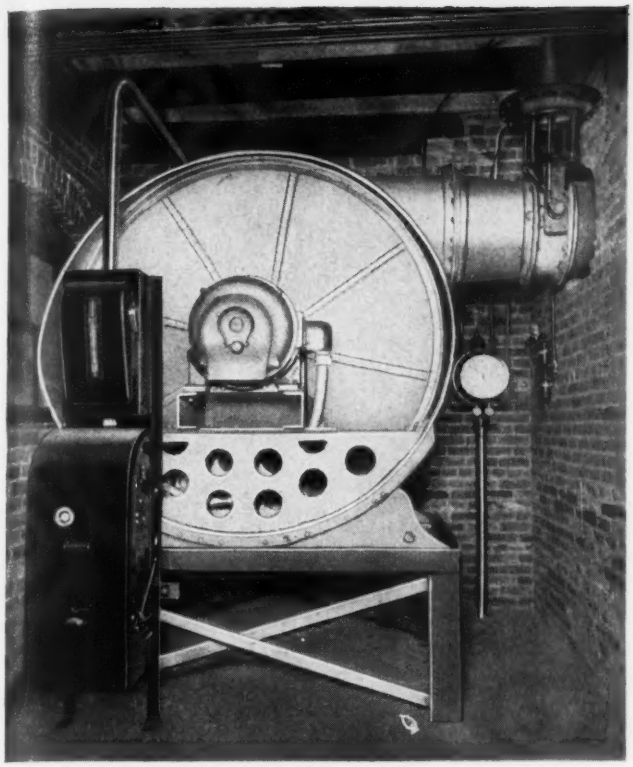
S. S. Deputy was graduated from Indiana University and became a sales executive with the International Business Machines Corp. He joined American Wheelabrator in 1946. He is a member of National Sales Executives Inc.

E. B. RICH

A. E. LENHARD

S. S. DEPUTY

BERNARD LESTER



SPENCER
HARTFORD

IN THE FOUNDRY

The first Spencer Turbo was installed on a cupola in Pittsburgh more than forty years ago, and is still giving satisfactory performance.

As foundry practice improved and became more exacting, the advantages of the Spencer Turbo for foundries became more and more important. Its very simplicity and freedom from shut downs and maintenance for instance became most valuable during the war years when foundries were working at top speed 24 hours a day.

The Spencer Turbo has wide clearances, with only two bearings to grease. It operates quietly, at low speeds and with little vibration. No special foundations are required.

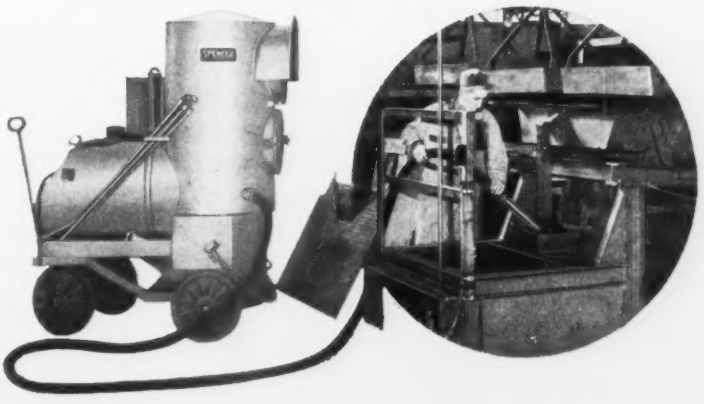
Positive Control: Spencer Turbos deliver a constant pressure of air regardless of cupola loading conditions. Manual control consisting of a calibrated ammeter and a blast gate is standard. Automatic air-weight control with chart readings can be added where required. Ask for the Spencer Foundry Bulletin No. 112.

A Mechanized Foundry Benefits Everyone

FOUNDRY EQUIPMENT MANUFACTURERS ASSOCIATION INC. MEMBER FEMA

GOOD HOUSEKEEPING

Spencer Portable Vacuum Cleaners from 1½ to 7½ horsepower are used extensively in foundries to remove overhead dirt and dust and to clean molds, patterns and finished castings. The same machine can be used in other parts of the plant for general housekeeping, or for reclaiming metals, material handling and a hundred other uses along the production line. Bulletins on request.



THE SPENCER TURBINE COMPANY • HARTFORD 6, CONNECTICUT

SPENCER
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414A

Here's the new DINGS "standard" for Lifting Magnets

LOOK RIGHT for the features that make this new all-welded Dings the answer to a crane operator's prayer. It's the most advanced magnet on the market — the biggest lifting magnet development in years. Back of it is Dings' 52 years' experience as the world's largest exclusive builder of magnetic separators and lifting magnets for all industry.

Let the Dings' Representative nearby tell you how the many exclusive Dings' features mean dollars to you. Call him up.

DINGS MAGNETIC SEPARATOR COMPANY
4708 W. Electric Ave., Milwaukee 46, Wis.

FEATURES

1. **LIGHT WEIGHT** — up to 21% lighter in some sizes than any other magnet. More of the weight your crane carries will be *payload*.
2. **ALL WELDED CONSTRUCTION**—greater shock resistance, moisture-proof.
3. **MORE LIFT** — after a full day's operation, size for size the new Dings will lift from 10 to 100% more than any other. This is due to (1) its extremely low temperature rise and (2) a properly balanced magnetic circuit.
4. **FOUR POINT CHAIN SUSPENSION** — less swinging and "tipping" when picking up a load not properly centered — added chain life.
5. **EXTRA HEAVY REINFORCED MANGANESE COIL SHIELD** — strength where it's needed—25% more protection for the coils.
6. **HEAVY LUGS** for tag line or drag line service.
7. **LEAD CABLE PROTECTED** by a metal shield. Cable connection at the center of the magnet body.
8. **WATER PROOF, SHATTER PROOF** jerk resistant molded neoprene neck cable connectors.
9. **TAMPER PROOF** sealed terminal box.
10. **ALLEN-BRADLEY** controls.

SEND FOR LIFTING MAGNET CATALOG

gives full description, sizes, capacities, etc.

Dings Magnets

World's Largest Exclusive Builder of Magnetic Separators and Lifting Magnets

TENTATIVE METHODS OF IMPACT TESTING OF CAST IRON

ASTM Designation: A 327—50T

(Concluded from June)

METHOD B. IZOD TYPE IMPACT TEST

Scope

7. This method of test has been developed to determine the shock resistance of gray cast iron. It is not suitable for testing austenitic or malleable cast irons.

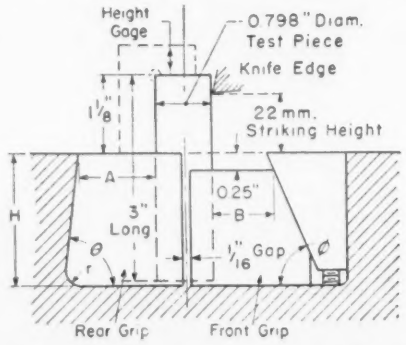
Note.—The single-blow impact test on notched bar test specimens described in the Tentative Methods of Impact Testing of Metallic Materials (A. S. T. M. Designation: E 23) has been found unsatisfactory for cast iron. For cast iron, the best consistency associated with a satisfactory range of results is obtained with a plain, machined, and unnotched test bar 0.798 in. in diameter (0.5 sq. in. in area).

Nomenclature

8. This test shall be known as the Izod Test for Cast Iron, and the results shall be quoted as . . . . . ft-lb. Cast Iron Izod Impact.

Apparatus

9. The single-blow Izod test for cast iron shall be carried out in a 110 or 120 ft-lb. pendulum type impact machine with a striking height of 22 mm. as used in the cantilever beam test for steel described in the Tentative Methods of Impact Testing of Metallic Materials (A. S. T. M. Designation: E 23). Modifications of the grips to accommodate the larger size of test piece are shown in Fig. 5.



Note—Dimensions A, B, H, r, angles and φ, and width of grips shall be determined for each machine. The grips shall be bored so that the test specimen is in line with the center of the knife edge of the pendulum.

Fig. 5—Modified grips for Izod type impact test

Test Specimens

10. The test specimens shall have a plain cylindrical form machined to a smooth finish, and shall conform to the following dimensions:

Diameter in.	0.798 ± 0.002
Length, in.	3 (see Note)

Note.—Some machines are designed to accommodate a longer bar passing through the base into the foundations. Where such facilities exist the alternative procedure of carrying out consecutive tests on a longer bar is permissible, provided that the height of the test piece above the rear grip is maintained at 1½ in. and the fracture at the top of the bar is reasonably level, and further that the total length of the test specimen is at no time less than 3 in.

Procedure

11. In all other respects, except as described above, the test shall conform to the appropriate requirements of the Tentative Methods of Impact Testing of Metallic Materials (A. S. T. M. Designation: E 23).

METHOD C. CHARPY TYPE IMPACT TEST

Scope

12. This test has been developed to determine the shock resistance of gray cast iron. It is not suitable for testing malleable cast irons.

Note.—The single-blow impact test on notched bar test specimens described in the Tentative Methods of Impact Testing of Metallic Materials (A. S. T. M. Designation: E 23) has been found unsatisfactory for cast iron. For cast iron, the best consistency associated with a satisfactory range of results is obtained with a plain, machined and unnotched test bar 1.125 in. in diameter (1.0 sq. in. in area).

Nomenclature

13. The test shall be known as the Charpy Impact Test for Cast Iron, and the results shall be quoted as . . . . . ft-lb. Cast Iron Charpy Impact.

Apparatus

14. The single-blow impact test for cast iron shall be carried out in a 110 or 120 ft-lb. pendulum type impact machine as used for the simple beam test for steel described in the Tentative Methods of Impact Testing of Metallic Materials (A. S. T. M. Designation: E 23).

Test Specimens

15. The test specimens shall have a plain cylindrical form, machined or ground to a smooth finish, and shall conform to the following dimensions:

Diameter, in.	1.125 ± 0.002
Length, in.	8 ± 0.5

Procedure

16. The bars shall be tested on a 6-in. span. In all other respects the test shall conform to the appropriate requirements of the Tentative Methods of Impact Testing of Metallic Materials (A. S. T. M. Designation: E 23).

SOME OF THE PHYSICAL PROPERTIES OF VARIOUS ELEMENTS

Element	Symbol	Atomic Weight	Specific Gravity	Lb per cu in. 20° C	Melting Point Deg. C	Boiling Point Deg. C	Linear Coefficient of Thermal Exp. Deg. F	Electrical Resistivity Michrom—cm	Atomic Number	Valence	Wave Length K^{α} in A.U.	Heat of Fusion Btu per lb
Aluminum	Al	26.97	2.7	0.0975	659.7	1800	13.3	2.669	13	3	8.3205	170
Antimony	Sb	121.76	6.68	.2391	630.5	1440	6.27	39	51	3, 5	.47387	68.9
Arsenic	As	74.91	5.73	.207	820	615(s)	2.14	35	33	3, 5	1.17743	....
Barium	Ba	137.36	3.5	.1265	850	950	....	....	56	3	.38899	....
Beryllium	Be	9.02	1.85	.0658	1350	2770	6.8	18.5	4	2	115.7	470
Bismuth	Bi	209.0	9.78	.3541	271.3	1436	7.47	115	83	3, 5	.16525	22.5
Boron	B	10.82	2.0	.0831	2300	2500	1.1	1.8×10^{12}	5	3	67.71	....
Cadmium	Cd	112.41	8.64	.3125	320.9	778	16.6	7.59	48	2	.53832	23.8
Calcium	Ca	40.08	1.55	.056	810	1440	13.89	4.6	20	2	3.35495	....
Carbon	C	12.00	1.88	.0679	3500	3500	.03–2.4	1375	6	4	.....	....
Cerium	Ce	140.13	6.90	.2508	640	....	....	78	58	3, 4	.36110	....
Cesium	Cs	132.91	1.90	.0676	26	670	54	18.83	55	1	.40411	6.8
Chromium	Cr	52.01	7.1	.2579	1615	2200	4.7	13.1	24	2, 3, 6	2.28891	136
Cobalt	Co	58.94	8.9	.3216	1480	2900	6.71	9.7	27	2, 3	1.78919	105
Columbium	Cb	92.91	8.4	.3305	1950	....	4.0	13.1	41	5	.74889	....
Copper	Cu	63.57	8.93	.323	1083	2310	9.3	1.682	29	1, 2	1.54123	91.1
Gallium	Ga	69.72	5.91	.214	30.1	2070	10	53.4	31	3	1.34037	34.6
Gadolinium	Gd	157.30	7.95	.287	....	....	....	....	64	3	.29261	....
Germanium	Ge	72.60	5.36	.194	958	1350	....	89,000	32	4	1.25521	....
Gold	Au	197.2	19.32	.6973	1063	2500	8.0	2.42	79	1, 3	.18483	29
Hafnium	Hf	178.6	13.3	....	1700	3100	....	....	72	4	.22653	....
Holmium	Ho	163.5	...	....	....	....	....	....	67	3	.26499	....
Iodine	I	126.93	4.94	.178	113.5	200	52	1.3×10^{15}	53	1	.43703	25.6
Indium	In	114.76	7.3	.264	155	....	18	8.37	49	3	.51548	....
Iridium	Ir	193.1	22.4	.813	2454	4449	3.8	5.3	77	4	.19550	....
Iron	Fe	55.84	7.86	.284	1530	2450	6.6	9.80	26	2, 3	1.93601	117
Lead	Pb	207.22	11.34	.409	207.22	327	16.4	20.65	82	2, 4	.17004	11.3
Lithium	Li	6.94	0.534	.019	186	1400	31	8.55	3	1	.....	286
Magnesium	Mg	24.32	1.74	.0628	651	1120	14.3	4.46	12	2	9.869	160
Manganese	Mn	54.93	7.42	.260	1230	1900	12.8	5	25	2, 3, 7	2.10149	115
Mercury	Hg	200.61	13.6	.489	−38.85	357.25	....	95.8	80	1, 2	.....	4.9
Molybdenum	Mo	96.0	9.3	.368	2535	3620	3.05	4.77	42	4, 6	.71210	126
Nickel	Ni	58.69	8.9	.320	1452	....	7.3	10.9	28	2, 3	1.65835	133
Osmium	Os	191.5	22.48	.813	2700	4900	2.6	9.5	76	6, 8	.20131	....
Palladium	Pd	106.7	12.16	.434	1549	2540	6.6	10.8	46	2, 4	.58863	61.6
Phosphorus	P	31.02	1.82	.0657	44.2	288	69	10	15	3, 5	6.1425	9
Platinum	Pt	195.23	21.37	.774	1755	3910	5.1	10.6	78	2, 4	.19004	49
Polonium	Po	210.0	...	....	600	....	....	....	84	2, 4, 6	.....	....
Potassium	K	39.10	0.86	.031	62.3	760	....	....	19	1	3.73707	26.1
Radium	Ra	225.97	5.0	.18	960	....	....	....	88	2	.....	....
Rhenium	Re	186.31	20	.72	3000	5740	....	....	75	7	.....	....
Rubidium	Rb	85.44	1.53	.0553	38.5	696	50	12.5	37	1	.92776	11.0
Selenium	Se	78.96	4.50	.174	217	690	....	12	34	2, 4, 6	1.10652	11.9
Silicon	Si	28.06	2.42	.087	1420	1690	1.6–4.1	85×10^{3}	14	4	7.11106	607
Silver	Ag	107.88	10.5	.38	960.5	1955	10.5	1.62	47	1	.56267	45
Sodium	Na	22.99	0.97	.035	97.5	880	39.5	4.6	11	1	11.885	49.5
Strontium	Sr	87.63	2.6	.094	900	1380	....	23	38	2	.87761	45
Sulphur	S	32.06	2.07	.075	112.8	444.6	36	2×10^{23}	16	...	5.3637	16.7
Tantalum	Ta	181.4	16.6	.60	2910	5425	3.6	15.5	73	5	.21973	....
Tellurium	Te	127.61	6.24	.224	451	1390	9.3	$5.8\text{-}33 \times 10^{3}$	52	2, 4, 6	.45491	13.1
Thorium	Th	232.12	11.5	.415	1842	3300	6.2	19	90	4	.1368	....
Tin	Sn	118.70	7.31	.264	231.9	2270	11.12	11.5	50	2, 4	.49402	26.1
Titanium	Ti	47.90	4.5	.163	1850	3300	3.96	80	22	4	2.74681	....
Tungsten	W	184.0	19.1	.698	3400	5100	2.2	5.48	74	6	.21337	79
Uranium	U	238.14	18.7	.676	1690	3500	....	60	92	4, 6	.13095	....
Vanadium	V	50.95	5.96	.205	1780	3200	....	26	23	3, 5	2.50213	....
Zinc	Zn	65.38	7.14	.258	419.4	930	18.3	6	30	2	1.43603	43.36
Zirconium	Zr	91.22	6.4	.23	2350	....	3	41	40	4	.78851	....
Argon	A	39.94	0.0017	.00006	−189.6	−186.1	....	....	18	0	.....	12
Bromine	Br	79.92	3.12	.113	−7.2	61.1	....	....	35	1	1.04166	29.2
Chlorine	Cl	35.46	(1.9)	....	−40	−33.6	....	....	17	1	4.7212	38.9
Fluorine	F	19.0	(1.3)	....	−223	−187	....	....	9	1	18.275	18.2
Helium	He	4.002	0.1785	$.601 \times 10^{-5}$	−271	−268.8	....	....	2	0	.....	....
Hydrogen	H	1.008	0.07	$.303 \times 10^{-5}$	−259	−252.8	....	....	1	1	.....	27.0
Krypton	Kr	83.7	0.003	$.126 \times 10^{-3}$	−169	−151.7	....	....	36	0	.9821	....
Nitrogen	N	14.008	0.0012	$.042 \times 10^{-3}$	−210.5	−195	....	....	7	3, 5	31.557	11.2
Oxygen	O	16.0	0.0013	$.048 \times 10^{-3}$	−218	−182.7	....	....	8	2	23.567	5.9
Radon	Rn	222.0	4.4(−62°C)	.159(−62°C)	−113	....	....	....	86	0	.....	....
Xenon	Xe	131.30	0.0055	.0002	−140	−109.1	....	....	54	0	.417	....

UNIVERSAL FLASK PINS

STAND PLENTY OF PUNISHMENT . . .

THUS SAVE REPLACEMENT TIME AND COST

Universal Flask Pins and Bushings are made to really stand up no matter how much punishment they're given in the foundry. They seldom break or bend—in spite of the beating they take on the shakeout. The bushings show a minimum of wear despite continuous use.

The reason: Universal Flask Pins and Bushings are heat-treated and precision ground from high quality steel with the same close tolerances found in machine tool work. Because they stand up, Universal Bushings and Pins save the cost and the down-time that replacement always requires. Because of their precise design and construction, Universal Bushings and Pins allow perfect cope and drag alignment. And because all standard sizes are carried in stock you get prompt delivery. Special sizes and types to order. Complete information is available by requesting the Universal Catalog covering Flask Pins and Bushings. Direct your inquiries and orders to the office nearest you —1060 Broad St., Newark, N. J., and 5035 Sixth Ave., Kenosha, Wisconsin—or write to our home office.

UNIVERSAL ENGINEERING COMPANY

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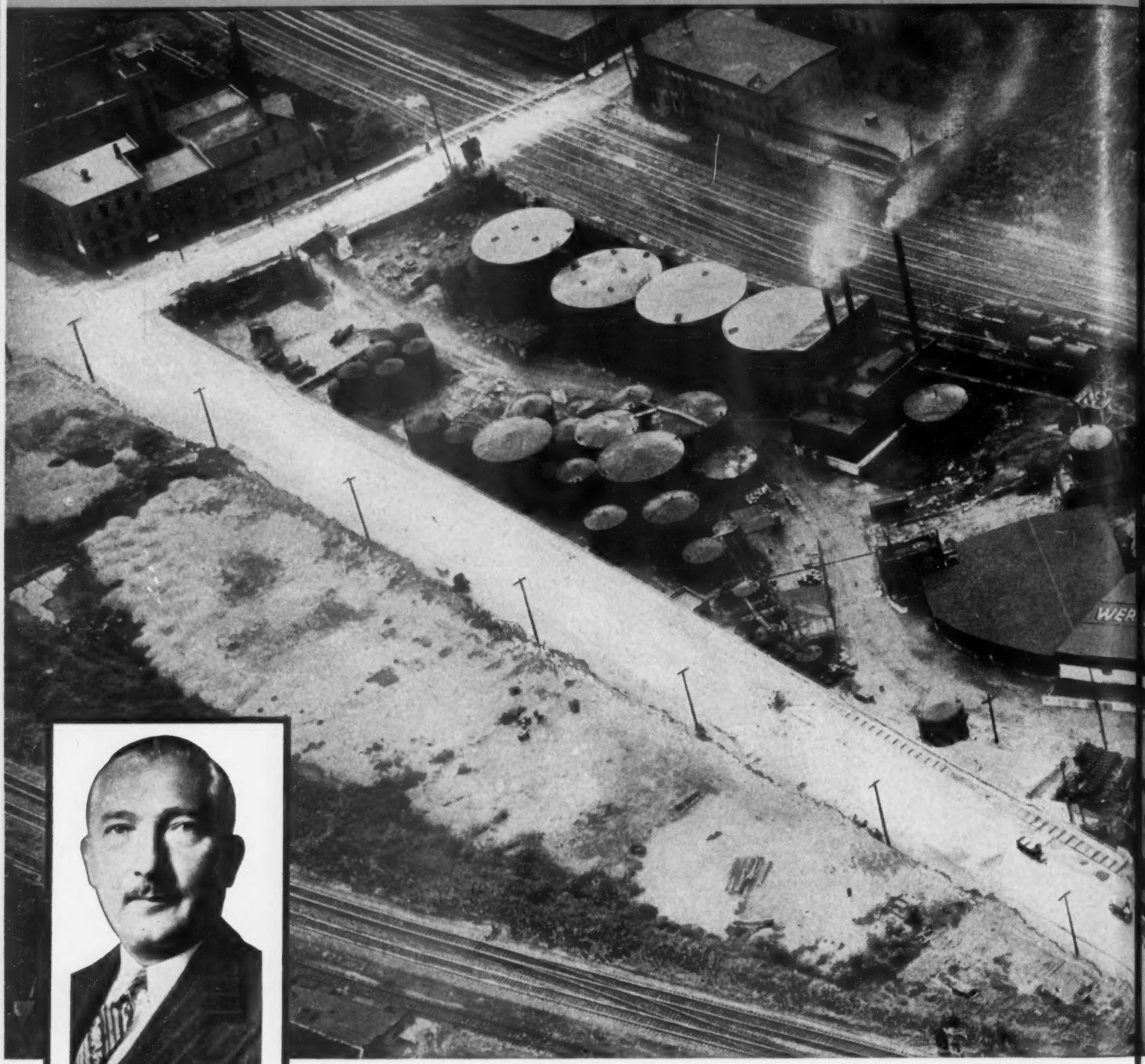

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4,000,000 gallons of vegetable oil tank storage (enough for 500 tank cars) permit large volume purchases to get the best prices... large bulk stocks iron out natural variations in raw materials—assure uniform core oil performance.

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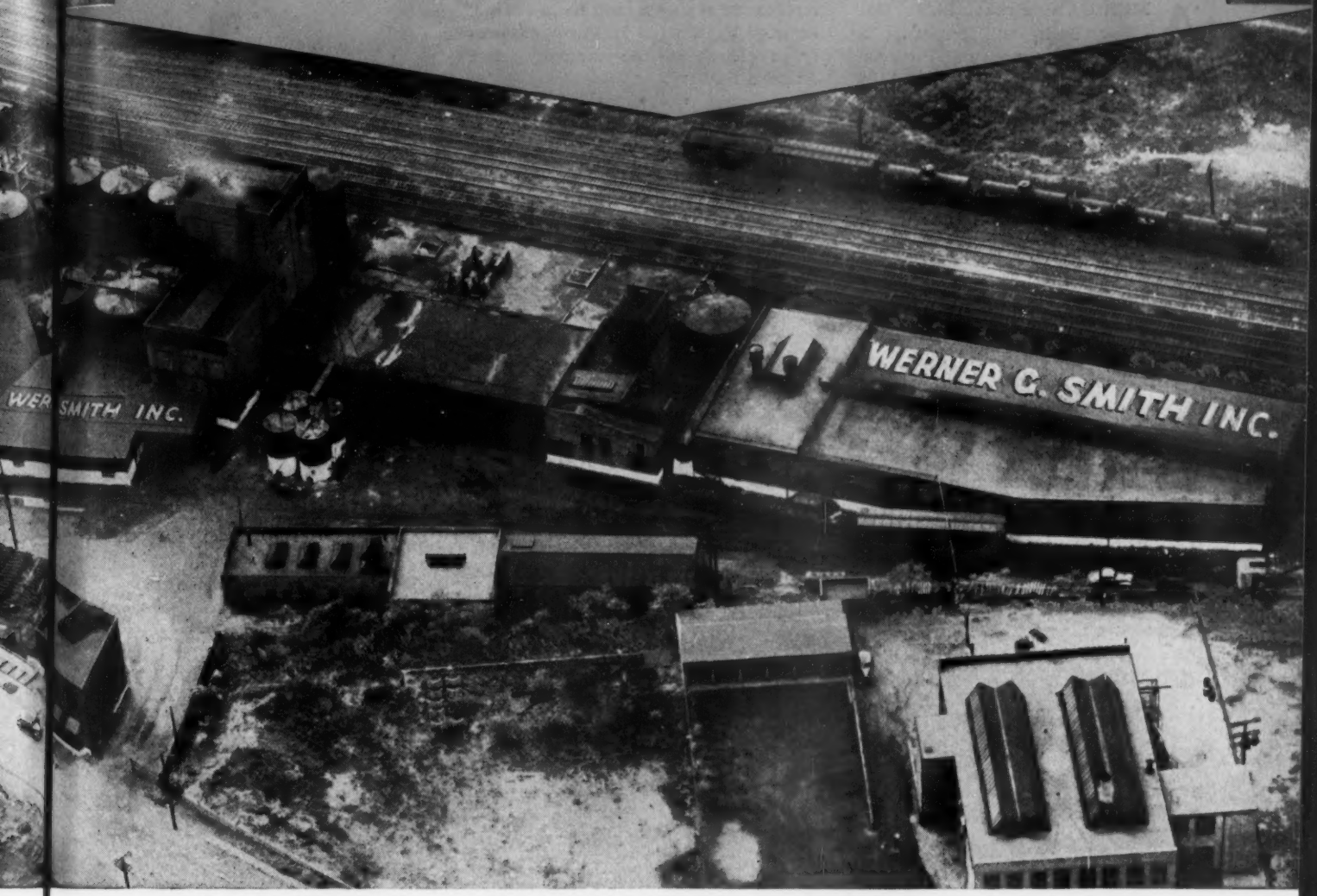
New Werner G. Smith Core Oils

Our new Cleveland, Ohio, core oil manufacturing plant has all the modern facilities needed to make the finest quality core oils of Werner G. Smith's years of formulating experience.



Here Werner G. Smith's 35 years of practical knowledge of core oil manufacture are backed to best advantage in our 51-tank plant—three private rail sidings, quality control laboratory, warehouse, mixing tanks, etc., provide all the modern manufacturing facilities to assure dependable supply to the largest foundries and fast delivery service to the smallest foundry.

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Industry BRIEFS

AMERICAN Brake Shoe Co., New York, will construct a $1 million foundry at Pomona, Calif., to replace its plant at 5309 East Slauson St., Los Angeles 22. Site of the Slauson Street plant was required for freeway purposes.

♦ ♦ ♦

Ross Products Co., 223 West Poplar St., Sidney, O., has changed its name to Sidney Aluminum Products Inc. Company makes special alloy aluminum castings and is headed by Howard L. Fleck, president; J. W. Wharmby, vice president, and Reese C. Gross, secretary-treasurer and general manager.

♦ ♦ ♦

Archer-Daniels-Midland Co. has opened a new product development plant at Minneapolis to serve as a link between the research laboratory and large scale production. Plant will be operated by the ADM Research Division headed by S. O. Sorensen, vice president. James Konen, director of research, will be in charge, assisted by Newton D. Farel, formerly in charge of the company's Los Angeles refinery.

♦ ♦ ♦

Ajax Foundry Inc., 59 Pleasant St., Randolph, Mass., is the new name and location of Everett Foundry Inc., 1865 Revere Beach Pkwy., Everett, Mass. Financial structure and officers remain the same with one exception: John T. Watson, formerly of Hall-Watson Co., has joined the company as superintendent.

♦ ♦ ♦

Link-Belt Co., 307 North Michigan Ave., Chicago 1, is constructing a plant for producing elevating, conveying, and processing machinery, on a 43-acre site at Colmar, Montgomery County, Pa. The 300,000 sq ft plant area includes a two-story office building and a cafeteria.

♦ ♦ ♦

Eutectic Welding Alloys Corp., 40-40 172nd St., Flushing, N. Y., has constructed an administration building, adjoining its manufacturing plant erected at Flushing last year, to house existing company branches, general and executive offices, and the company welding institute.

♦ ♦ ♦

Bellevue Industrial Furnace Co., manufacturer of industrial heat treating and melting furnaces, has moved its plant and general offices to 2620 Crane Ave., Detroit 14, and is constructing a new building in addition to existing buildings at the new location.

♦ ♦ ♦

Eastern Malleable Iron Co., Wilmington, Del., held open house May 20 for its employees, their families and friends, and members of the community. Conducted tours showed visitors the development of a casting into a final product ready for shipment.

♦ ♦ ♦

Buffalo Foundries Inc. has been incorporated in New York state by Raymond W. Conklin, 135 Meadow Lane, Kenmore, N. Y.; Harlan J. Swift, 309 Lincoln Parkway, Buffalo, and Edwin O. Tilton, 59 Canterbury Center, Eggertsville, N. Y.

♦ ♦ ♦

General Refractories Co., Philadelphia, will construct a $3 million silica refractories manufacturing plant on a 29-acre site near the city limits of Warren, O., as part of a general $12 million expansion program.

♦ ♦ ♦

Progressive Brass Foundry Co. has been incorporated in the state of New York by Nazareno Gullo, 3764 72nd St.; L. William Santasiere, 3764 87th St., and Ethel Salzberg, 155 Ross St., all of New York.

♦ ♦ ♦

Foundries Inc., 610 Third St., Dallas, Tex., has acquired the property and equipment of Texas Pattern & Mfg. Co., Grand Prairie, Tex., and moved its operations to Dallas.

♦ ♦ ♦

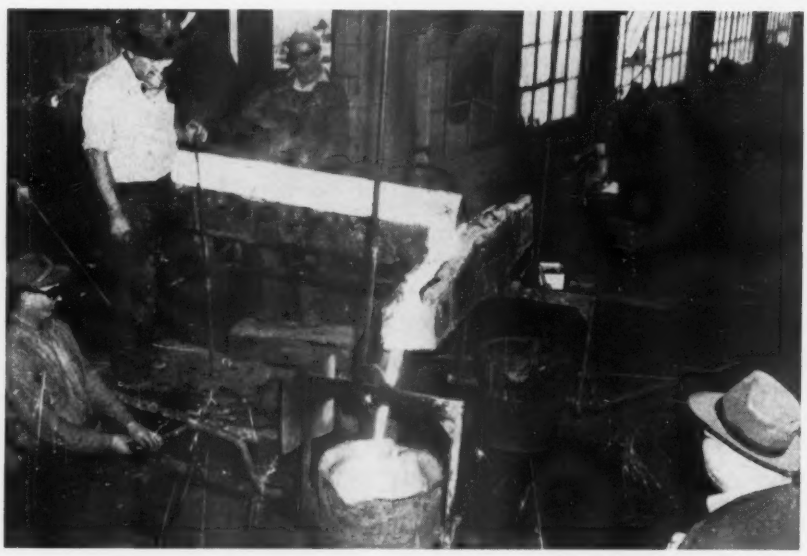
Ferro Machine & Foundry Inc., 3155 East 66th St., Cleveland 4, is constructing a two-story building, adding about 35,000 sq ft of floor space to its plant.

♦ ♦ ♦

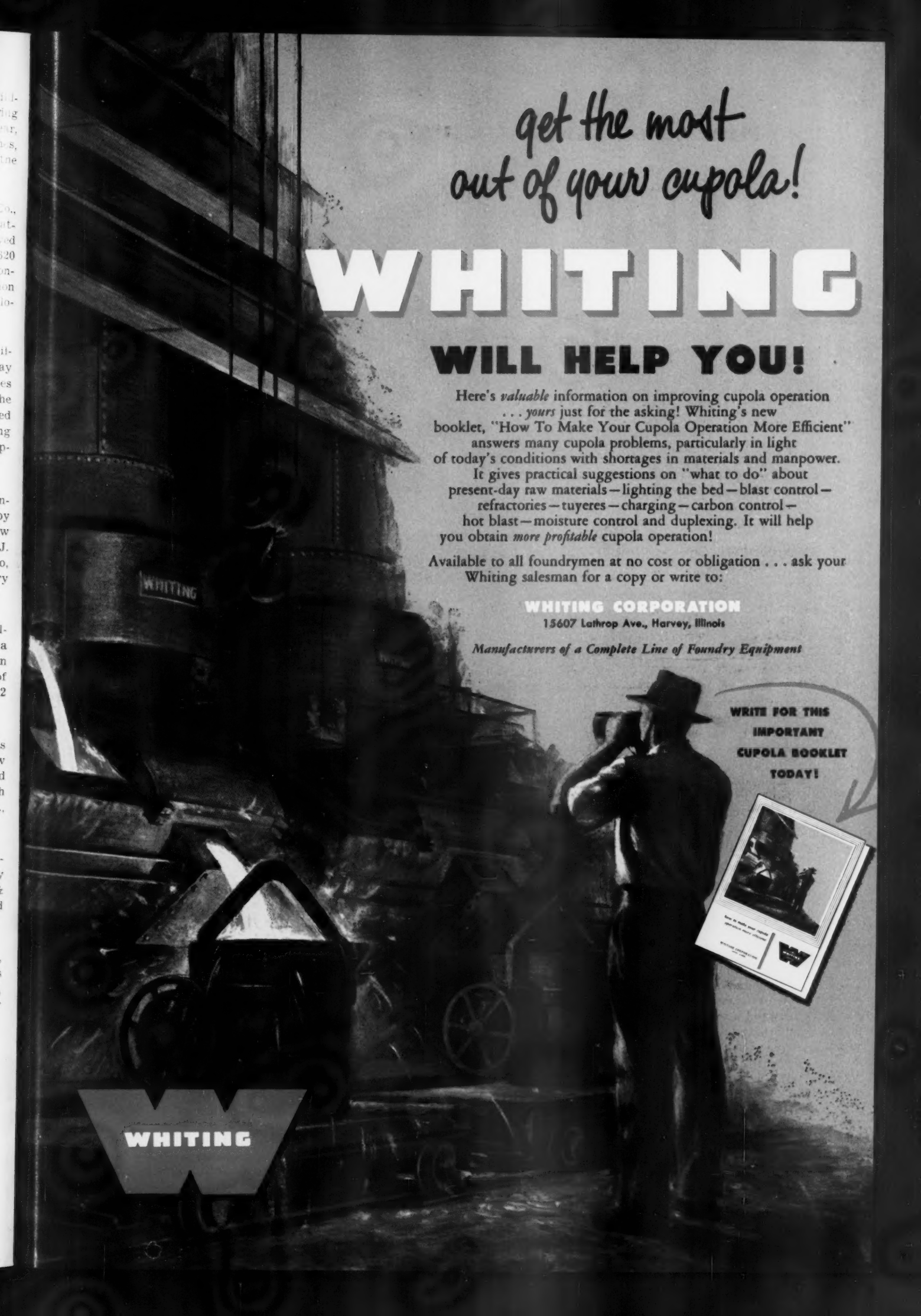
Valley Foundry & Machine Works Inc. May 21 officially opened its new plant containing 90,000 sq ft of floor space at 2718 East Ave., Fresno, Calif.

♦ ♦ ♦

Lufkin Foundry & Machine Co., Lufkin, Tex., formally opened its new sales and service branch at 605 Fort Worth Ave., Dallas, Tex., on May 24.



FIRST METAL was poured recently at the newly acquired Reedsburg, Wis., plant of Grede Foundries Inc., Milwaukee. Present for the occasion, left to right, were: Eddie Gawronski, Reedsburg; William Sonderhoff, superintendent of the Grede Spring City Division, Waukesha, Wis.; Donald Weitzel, Reedsburg, and Paul Woehlke, Milwaukee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WHITING

How to use the CUPOLA

By BERNARD P. MULCAHY
President
Fuel Research Laboratory Inc.
Indianapolis

Characteristics of foundry coke and the requirements of a fuel for satisfactory use are described in this seventh article of a series discussing cupola operation

COKE varies in native characteristics due to a number of reasons, which included:

1. Origin of coal used, and mixture employed.
2. Temperature of carbonization.
3. Plant operating techniques.

It has already been shown (June FOUNDRY) that beehive coke differs from by-product coke due to the type of ovens employed. The most noticeable difference is the shape and size of the individual pieces.

Coking coals vary considerably in their properties because of the age, geology and original plant life. In turn, these characteristics are transferred in part to the final coke. The effect of ash and sulphur in the coal is self-evident and it is recognized that both should be as low as possible.

One of the most important measurable factors in coke is the residual volatile matter content. This is the gas or tarry bitumens remaining, measured as volatile matter. This is important because the combustibility of the coke is directly affected by the content of this material. As the V.M. increases in the coke the more easily it is burned and this is injurious to the melting process because the coke burns faster, making it difficult to maintain the proper bed height and avoid oxidation.

The next most important factor in coke is its size, or more correctly stated, size consist. This affects its use in two ways: 1. The permeability of the bed and the proper distribution of the gases. 2. Its rate of combustion, due to coke surface exposure.

Next to size, we have the factor of strength. That is its ability to resist degradation in handling. Here we will note that although we talk of strength our real interest again is size.

Another factor also bears on a coke's use. It is referred to as stability and hardness indices, and is measured by the tumbler test. This is a measure of a coke's "softness" or its resistance to degradation by attrition. This contrasts to the "hardness" as measured by the shatter index. This factor also is directly related to its combustibility in most instances.

We have mentioned combustibility of coke several times; actually there is no reliable or commonly accepted test for this factor, but it is measured indirectly by the V. M. content and the tumbler test (in part).

In addition, another important factor is its apparent specific gravity, which reflects the density of the coke piece. This factor also affects its combustibility.

Still another factor is its bulk density or weight per cubic foot, which is related to the size consist and the apparent specific gravity. This bears on the amount of coke occupying a given volume such as the coke bed.

Moisture—Moisture in foundry coke is generally misunderstood and frequently blamed erroneously for malperformance. Because of its porous structure coke is commonly conceived to have high absorptive capacity of moisture; this is not true, because the cells are not continuous and it does not act like a sponge. Actually, moisture in coke is generally inversely proportional to its size—the larger the coke the less the moisture. For example, a foundry coke of 4 x 5-in. size would generally have a maximum moisture content of 4-5 per cent, while a coke of 1-in. size could have a moisture content of 12-15 per cent.

Brown Spots of "Speckled" Coke—This is due to the rusting (Fe_2O_3) of the iron in the ash of the coke. It is not injurious to the coke.

Other measurable factors help to distinguish cokes, but those mentioned are the principal ones and which will in most cases distinguish, identify and account for the differences noted in performance of various coke.

Requirements — The requirements of a good coke are:

Size—One of the desirable characteristics here is that the coke be regularly sized, i.e. contain a minimum of fines in order to produce a good permeable structure in the bed. Larger cupolas require the larger coke because of the greater quantity of air used and the larger diameter or distance the air must travel through and into the center of the bed.

The influence of fines in a coke is tremendous. Ten per cent fines (−1½ in.), for example, will seriously affect an otherwise good coke by plugging the voids between the pieces. A good general size relationship of coke size requirement for a cupola is 10 per cent of the diameter. For example, a 48-in. cupola should have a coke sized 4 x 5 in. or averaging 4.5 in.

Volatile Matter Content — This should not exceed 1.0 per cent.

Strength, Impact—Although this factor is measured regularly by individual coke manufacturers, there has not been established any commercial limits. It is not possible, therefore, to suggest any generally applicable dimensions in this regard. Another difficulty attached to this problem is the difference in the amount of handling at individual plants. It is sufficient to point out that a coke should be reasonably resistant to impact breakage with normal handling. This, of course, cannot include the excessive abuse a coke receives if

(*Concluded on page* 188)

AJAX

Lo-Veyors prove that

the cheapest way to handle sand is NOT to handle it

It is a generally accepted fact in the foundry industry that 100 pounds of material are handled for every 10 pounds of castings produced. There is no money in moving foundry sand with wheelbarrows.

That's why foundrymen are cutting costs and speeding up production with Ajax Lo-Veyors.

They are self-contained, vibrating conveyors ready to set in place and use. Easily installed on your floor, below your floor or suspended from wall or ceiling.

Reciprocating drive unit is completely enclosed...no exposed bearings or idler pulleys subject to rapid wear by sand.

Low first cost, low operating cost, low maintenance cost...it will pay you to look into Ajax Lo-Veyors.

AJAX FLEXIBLE COUPLING CO. INC.

204 English St., WESTFIELD, N. Y.

(*Concluded from page* 186)

handled at any time with a clamshell bucket.

Ash—A good ash level today would be 8 - 10 per cent. Formerly this was 6 - 8 per cent but all coals nationally are higher in ash today because of increased mechanized mining and worsening of the coals themselves.

Sulphur—Under today's condition a good coke would contain not over 0.80 per cent, although a coke containing 1.00 per cent would be classed satisfactory.

It is not possible to specify any other factors of coke because there is not universal agreement on their limitations or influence.

Testing — Very few foundries test coke, principally because of the common concept of its complexity and the many different opinions existing on the value or influence of the various characteristics. To evaluate a coke satisfactorily it is necessary to measure only a few characteristics:

Size—This is done by a screen analysis such as —2, 2 x 4 in., + 4. This will yield all the size information needed.

Strength—This can be done by the shatter test, sampling as the coke is unloaded, or an indirect index can be obtained by screening at the point of receiving, and again at the charging dock. This will give a measure of its actual degradation.

Volatile Matter—ASTM test only should be used. This will give a ready index of its combustible character.

Sulphur and Ash (ASTM) —This should be run periodically. It is not necessary to run these as frequently as the other tests because these factors generally are slower changing in a coke from an individual source.

All tests should be conducted in strict accordance with ASTM procedure, and sampling must be done very carefully, watching particularly that representative samples are obtained.

(*To be continued next month*)

BALANCE
SAFETY
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3 Features of
FOX
SWING FRAME
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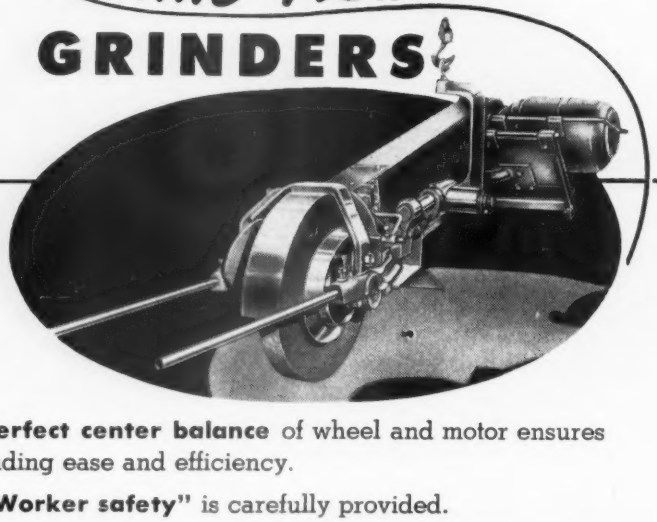

- **Perfect center balance** of wheel and motor ensures grinding ease and efficiency.
- **"Worker safety"** is carefully provided.
- **Greasing** required only once every six months . . . guaranteed for two years against repairs, exclusive of electrical equipment.

FOX GRINDERS, Inc.
OLIVER BUILDING PITTSBURGH 22, PA.

London Branch of IBF Marks 40th Anniversary

This year marks the 40th anniversary of the London branch of the Institute of British Foundrymen. The institute was founded in 1904 and was incorporated by royal charter in 1921. The London branch, known then as the British Foundrymen's Association, was constituted on Feb. 24, 1911, with Percy Longmuir as the first president. Among the 50 foundrymen present at that meeting were Robert Buchanan, H. Pilkington and J. Ellis, who later became London branch presidents.

Largest local foundry group in Great Britain, the London branch has furnished a number of national presidents including J. Ellis, Wesley Lambert, W. B. Lake, V. C. Faulkner, J. W. Fardom, and R. B. Templeton.

Book Review

The AMA Handbook of Wage and Salary Administration, edited by M. Joseph Dooher and Vivienne Marquis, cloth, 416 pages, 6 x 9 in., published by American Management Association, New York. Price $7.50.

An integrated compilation of the best material on wage and salary administration that the association has published, plus new research material on wage surveys, union contract provisions covering office salary administration, and job evaluation forms, this book is designed as a guide to principles and techniques of wage and salary administration.

It sets forth basic principles and requirements that must be considered at every stage of planning and administration. It is useful for setting up a formal program of wage and salary administration.

Statistical Quality Control

(*Continued from page* 97)

range values are not included in these "incentive" charts. However, the melters understand the basis on which these charts are laid out and they frequently observe the "master charts" from which the breakdown is taken.

These incentive charts are posted side by side in the melting superintendent's office and are reviewed by the melting superintendent and each melter at regular intervals. The "master charts" are kept posted on a "quality control board" in the metallurgical department office where they are readily accessible to all who are interested in the subject directly or indirectly.

One further step taken in connection with this charting is the preparation from it of (1) a monthly summary report for the manager of the works and (2) a summary report at intervals of about every two months by a representative of the research department for the vice president of the company and for the works manager. By use of these statistical methods, a measure is had for evaluating control steps which is both accurate and meaningful and whereby management can obtain a concise picture of what is going on in the process.

Show Tangible Benefits

Because carbon and manganese control is important, tangible benefits have accrued from endeavors to control them. Perhaps the most important of these is the increase in uniformity brought about in the entire process through attempts of the operators to keep these elements within control limits. This improved control is especially noticeable in greater uniformity of physical properties of the steel and in greater uniformity in heat treatment. Since National Malleable operates on a production line basis, any change that produces more uniformity in the process is reflected and recorded as a worth while improvement.

Especially has this been the case of a grade of medium-manganese steel which is produced in considerable quantity. Manganese control in the range of 1.30 to 1.50 in steel produced by the acid electric process is usually quite erratic and the early control charts showed this condition very markedly. The breakdown of these control charts by melters (also by first helpers) showed which turn had the greatest spread of results, and steps were then taken to improve the technique of the men involved. The charting was continued and comparison made with the previous results so that any changes in results were quite apparent. As a result, the distances between control limits was reduced from 0.4 per cent manganese to about 0.25 per cent. Along with this change, the scatter of individual results was greatly reduced so that the heat treatment could be set up on a more uniform basis and more uniform mechanical properties were produced.

It is extremely difficult to evaluate benefits of any one set of controls in terms of dollars and cents. Anything that can be done to increase uniformity of processing, to speed production through the shop, to reduce the amount of reheat treatment or of reworking required, to lower scrap losses and produce higher quality material will all be reflected in lowered costs of production.

Up to this point the discussion has been concerned entirely with the use of charts to control carbon and manganese analyses. These were selected because they are "naturals" for such charting for the following reasons:

NOW...Improve Castings with Skilkast*

New, inorganic additive proves advantageous for three basic foundry applications

ACTUAL foundry experience has demonstrated that Skilkast, a valuable new material, offers great benefit to foundrymen. Processed from perlite, a volcanic rock, Skilfast has remarkable properties which have already been put to work with outstanding success in these three important ways:

1. *As an additive to core sand.* Here Skilkast, which has a honeycomb type of structure, provides the advantage of greater permeability for venting gases. It likewise affords better blowability with sticky core sands.

2. *Added to molding or facing sands,* Skilkast acts as a cushioning agent to reduce expansion defects and subsequent rejects. It virtually eliminates buckles and rat tails; cuts cleaning and finishing time in many cases.

3. *Used on risers,* Skilkast provides effective heat insulation. It improves yield by helping control directional solidification.

Skilkast is processed under rigid controls to assure uniformity. It is dry, lightweight, furnished in 4 cu. ft. paper bags. Sold through foundry supply houses. Write for test sample.

Skilkast* is a member of the Grellex* family of perlite industrial products manufactured by Great Lakes Carbon Corporation, Perlite Division, 18 East 48th Street, New York 17, N. Y.

* *Trademark*

1. The source of data can be accurately measured, is secured at regular intervals, and is carefully tabulated as soon as the analyses are made. The charts are kept up to date and are accurate.

2. The charting is done on a basis that has a physical meaning and that can be understood by the operators.

3. Changes in level or range can be readily noted and, if corrective steps are taken, their effect is easily measured.

Many other operations in the foundry processes can be measured equally well and their measurements charted. In general, three classes of charts are kept: (1) process control charts. (2) product measurement charts. (3) per cent defective charts.

As the designations indicate, the first group is made up of those made from measurements taken during the process itself, such as chemical analyses, sand properties, mold hardnesses, core dimensions, amount of welding rod used per coupler, etc.

The second class of measurements includes those made of the physical properties of the steel produced, measurements of casting dimensions, th fit of moving parts, and similar measurements.

An example of this type of chart is shown in Fig. 9. Here the distanc is measured between the journal bo wedge lugs on a 5½ x 10 side fram Two measurements are made on eac lug, at the top and at the bottom o the lug and specification limits ar set up as noted on the chart. Again the measurements are grouped int groups of four readings, which hav been recorded on forms provided fo that purpose. The average value fo each group is shown on the chart as is also the range.

When the measurements were first started, it was obvious that the distance at the bottom of the lugs was considerably wider than the specifications permitted, while the distance at the top was within specifications. Again, it should be noted that the values shown are averages for four consecutive readings and that individual variations are thus minimized. As noted on the chart, a pattern correction was made and then both top and bottom measurements fell within specification limits. Subsequent readings were plotted from day to day and control limits calculated for each group of ten average top readings. There was a gradual change in the level of these averages until at the right side of the chart the level is almost exactly in the middle of the specified range, the averages are fluctuating normally about this level, and almost all are within the control limits. The change in spread or range of the results is also noted at the bottom of the chart.

Aids Making Corrections

By the aid of such a picture, the foundry superintendent and his associates are able to make pattern changes or other corrections intelligently as they are needed and thus avoid conditions that may lead to excessive finishing labor, as with the previously mentioned example. It has been found that when some critical locations are selected to measure, the measurement sometimes is quite satisfactory over a considerable period and frequently such measurements are then abandoned and others substituted. On the other hand, sometimes unsuspected conditions are uncovered, as was the case in the lug example. At other times further investigation will show that the cause of the trouble is not the one that was suspected but a related condition which can then be corrected immediately.

A third class of charts is regularly

Need core plates that SPEED PRODUCTION?

. . . then use TRANSITE CORE PLATES that are light-weight and easy to handle

You'll find two important reasons why Transite* Core Plates mean faster production: First, core makers can handle more plates with fewer trips. Second, Transite Core Plates are easier to clean . . . core wash, sand, etc., do not adhere to them as readily as to other core plate materials.

*Reg. U. S. Pat. Off.

Here are more *reasons why you can profit by using Transite Core Plates:*

They give long service—Made of tough, fibrous asbestos and cement, Transite Core Plates resist shock and corrosion—will not crack or break easily—require little, if any servicing. *Performance records of 8, 10 and 12 years are not unusual.*

They maintain accuracy — Transite Core Plates stay smooth through long, hard service. Foundrymen who have used them for years report minimum warpage.

For cores of large mass and small surface area, perforated Transite Core Plates are also available to eliminate green cores and reduce baking time. For full details write Johns-Manville, Box 290, New York 16, N. Y.

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Johns-Manville TRANSITE CORE PLATES

Made of Asbestos

maintained to give a picture of the defective castings that are being produced. Such charts are kept on a slightly different basis than the control charts described, and are known as "P-Charts" or "Fraction Defective Charts." In the interests of brevity a description of them will not be included but essentially they are pictures of defective castings which show the type of defect from each pattern number and heat, and the location of the casting in the pouring order. Such pictures are much better guides toward finding and correcting the difficulties involved than looking at a listing of the scrap castings posted on a bulletin board.

Such charts as have been suggested are posted at the location where they will receive the most attention from the supervision most concerned. For example, charts showing sand properties are posted in the sand laboratory; those showing core and dimensional measurements of casting with which the foundry is directly concerned are posted in the foundry superintendent's office; mechanical property charts are posted in the inspection department offices and also in the metallurgical department office.

One Man Does the Work

Almost from the beginning of National Malleable's attempts at statistical quality control, one man has devoted practically all of his time to the work. He does most of the charting (although some of the charting is done by such men as chemists, the sand technician, etc.), he reviews the charts at regular intervals and makes recommendations as to corrective steps that should be taken; and he issues periodic reports on the status of the several projects to management. He is attached to the staff of the metallurgical department because management feels that such an arrangement gives him a detached viewpoint.

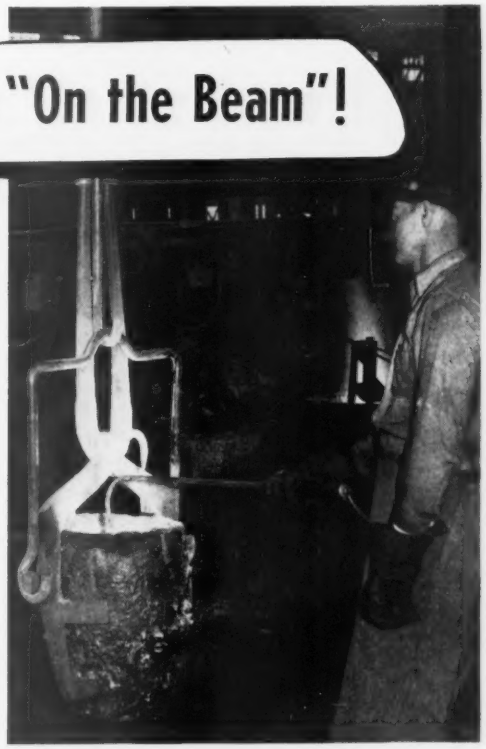
Casting measurements are largely made by a representative of the inspection department; core measurements by a man from the pattern department; and such measurements as mold hardness by the foundry engineer. In other words, every effort is made to have the data taken and interpreted by impartial persons who can made intelligent recommendations. Obviously there are other ways in which the quality control work can be set up but this way has proved very satisfactory.

One other factor to be considered in making such a setup is the nature of the production. The production at National Malleable is composed of medium sized castings for railroad work, where almost every casting carries a heat identification stamped on it and where it moves through almost a continuous process. If a shop is producing many small castings (as in the case of the malleable shops, for example) such details as the sampling of the castings would be very different from those of a shop producing only a few large castings. The principles underlying the control scheme are the same, however, for all types of work, and any attempts at quality control should pay big dividends.

Describes Tests for Respiratory Devices

Department of the Interior, Bureau of Mines, Publications Distibution Section, 4800 Forbes St., Pittsburgh 13, offers circular 7600, "Bureau of Mines Approval System for Respiratory Protective Devices." It describes the bureau's voluntary system for approval, based upon performance tests, of devices affording protection against breathing gases, dusts, and fumes.

Temperatures "On the Beam"!



Hot-junction tips of Marshall Thermocouples instantly renewable.

Quality control in castings begins with control of pouring temperatures! Metals must be poured at correct heat to produce strong, sound castings, free from flaws.

You can have that kind of metal temperature control! Marshall Enclosed-Tip Thermocouples will tell you exactly how hot your molten metal temperatures are! You can make sure your molten brass, bronze, aluminum and magnesium castings are poured at proper heat.

Marshall Thermocouples lower your production costs, increase plant efficiency. They enable you to give your customers still better castings. L. H. Marshall Co., 270 W. Lane Ave., Columbus, Ohio.

MARSHALL
THERMOCOUPLES

Adventures of BILL

By PAT DWYER
Illustrations by RICHEY

EVERY morning," Bill said, "well, nearly every morning I take a quick gander through the morning newspaper. Just force of habit. If some extraordinary combination of circumstances jammed me into a corner where I had to supply a convincing answer to the question 'Why do you read the paper every morning?' I am afraid I should find myself in the embarrassing position of many quiz program contestants. The quiz master says 'Which hand do you cut your meat with?' Whether the quivering victim says 'right' or 'left' he loses the T-H-O-U-S-A-N-D Doll-Ah prize and his self-respect when the ogre on the platform inquires sarcastically 'Why don't you use a knife and fork?' Always good for a hearty round of applause from members of the overflowing studio audience who know all the answers all the time."

"The chance of any nosey person asking you to give a reason for reading the morning paper is rather remote," I replied. "That is at least one worry you can check off the list. However, as a confirmed newspaper reader afflicted with a mild case of curiosity, I should like to know why you look on newspaper reading as a useless performance, or so much wasted effort. Perhaps, as the boys say, I did not get you in a somewhat rambling statement including reference to grand prizes, and right and left hand knives and forks."

"For a wonder Ol' Pal you got me right the first time. If I had the time and you had the good manners and patience to listen, I could give you forty-seven reasons for my hostile newspaper attitude. I can see by the shifty gleam in your little weasel eyes, you are trying to hatch an excuse for running out on me. I shall just mention one, a certain column that appears regularly every day, and every day sets my teeth on edge."

"Man and boy," I assured Bill solemnly, "man and boy for more than half a century I have heard excuses for sins of omission and commission, but without the slightest shadow of a doubt if I live to be one hundred and fourteen, a genuine hoary old age, I'll never hear one equal to yours. You do not like a certain column, therefore you will stop reading the paper. Why don't you skip the column if you don't like it? If you cannot think up a sufficiently crooked answer to that question, maybe if I twisted your arm hard enough you might be willing to confess why the column irritates you. Is the author hopelessly and persistently out of step with the band on questions of religion, politics, finance or the state of the nation?"

"Nothing of that kind," Bill waved a hand in airy dismissal. "The author is not concerned with serious subjects. She confines herself to a hodge-podge of light and airy odds and ends and local gossip."

"In the name of Matthew, Mark, Luke and John, hold the horse till I get on, what is there in the innocuous mess to make you to see red and run amok?"

"Most of the stuff is only mildly nauseating. Let me put it this way. Have you ever sat at table with a dumb bunny who screeched his knife blade across a plate? In the old time school days were your ears ever tortured by a dear little tone-deaf thug or thugess who drew an upright pencil across a slate?"

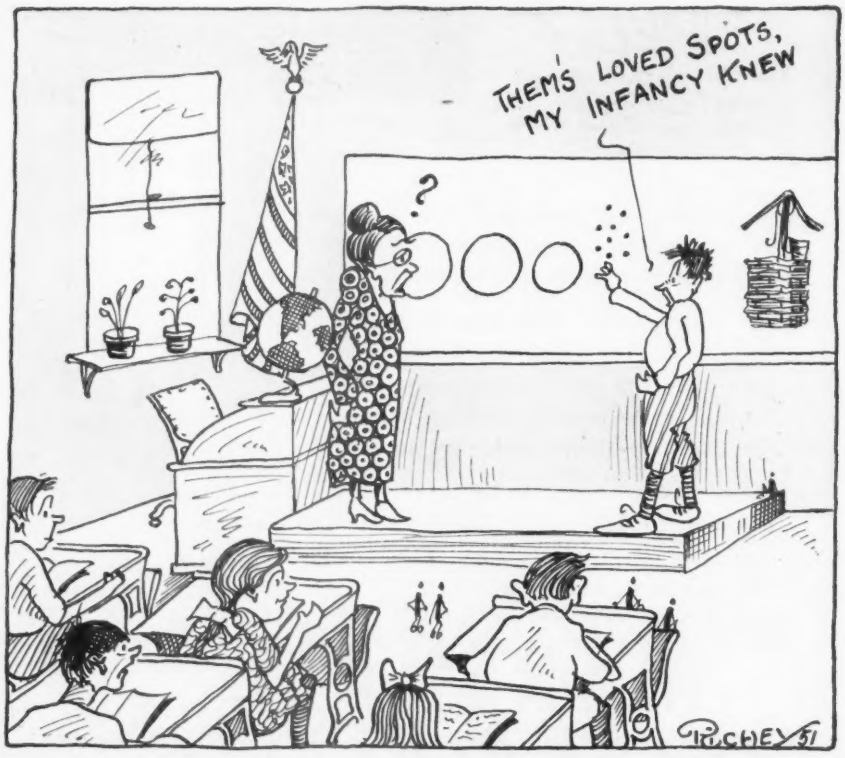
"You mean this columnist hands out screeching hot stuff?"

"Worse than that. She sprinkles one or two anecdotes in each serving. Usually anecdotes that have been going the rounds since before the first boat load of refugees blundered in past Cape Cod and landed on Plymouth Rock. Laboring under the same delusion as many amateur and public speakers she assumes that the anecdote will land with greater force if she boldly claims that she is the central figure, or that it came from a very dear and truthful friend and therefore is genuine blown in the bottle, all wool and a yard wide, double milled, double twilled and double struck in the weaving. In other words, it is the pure quill.

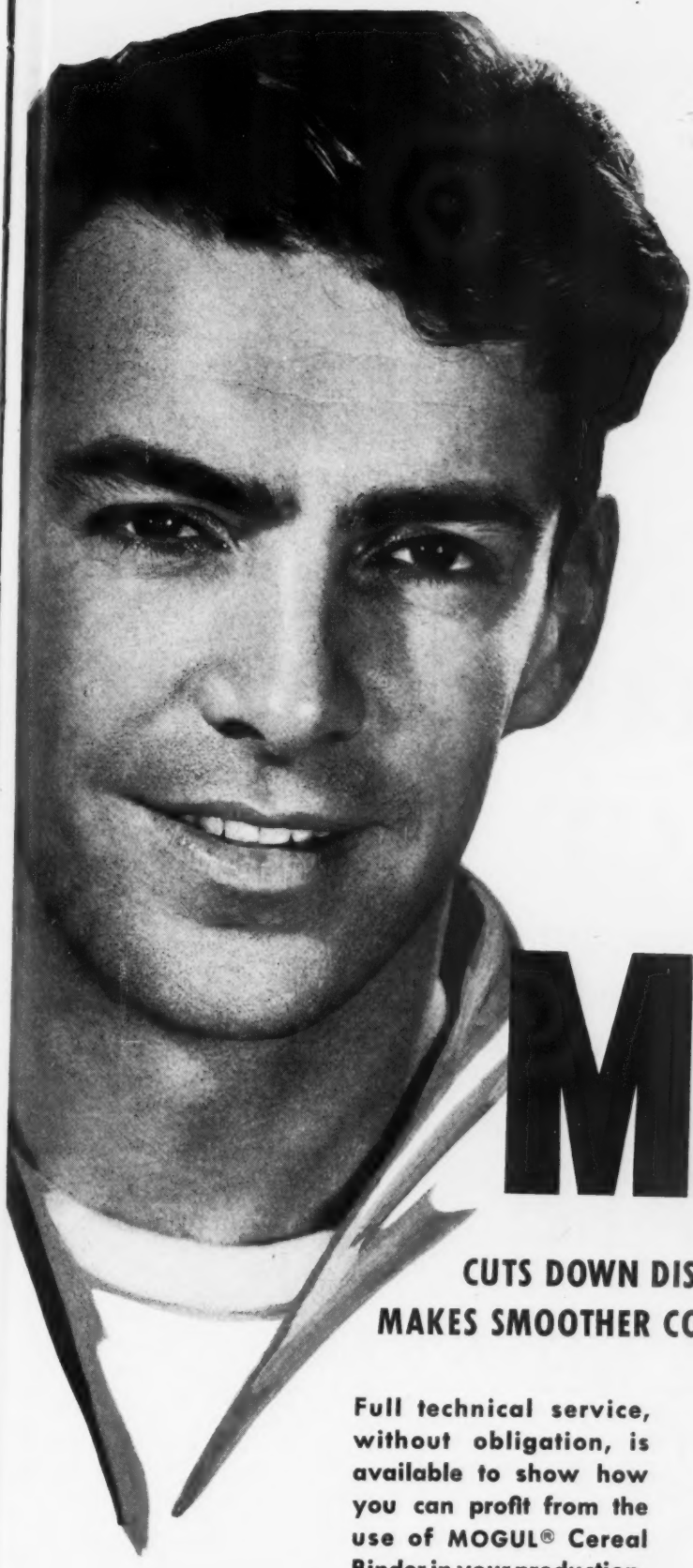
"One day last week she submitted the old oaken bucket school story. In an introductory sentence she announced that the item had been phoned in by a local school teacher, who vouched for the authenticity. She said she had taught the class of young square and round heads how to sing 'The Old Oaken Bucket.' To add the customary psychological touch she had requested each pupil to take a sheet of paper and set down the vision conjured in his or her mind by the words of the song.

"She was more than mildly astonished and puzzled when one brave young warrior handed in a sheet containing a freehand sketch, one large circle, four smaller circles and a number of black dots.

(*Continued on page* 194)



One of the greatest victories in constant battle between teacher and pupils



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the preferred dry bond for cores

Write Technical Sales Department

CORN PRODUCTS REFINING COMPANY
17 Battery Place, New York 4, N. Y.

(*Continued from page* 192)

" 'Very interesting Master Richard' she commented. 'Kindly step up on the platform, draw the same design on the blackboard and explain it for the benefit of the other boys and girls.'

" 'They ain't nothin' to it,' our hero explained modestly. 'This here big circle over here is the well. The first small ring is the old oaken bucket, the second is the rude bucket, the third is the moss covered bucket. And this here one at the end of the line is the bucket that hung in the well!'

" 'And what,' the teacher insisted, 'are those black dots?'

"He looked at her pityingly. 'Them there black dots? Why them is the loved spots my infancy knew!' "

"If you will accept a word of advice from a true friend and well wisher, the same being none other than the present speaker, Bill my dear young fella, you will hesitate before deciding to quit reading the morning paper. Adopt the broad viewpoint. The columnist may be the innocent victim of a frustrated school teacher with a distorted sense of humor. How would you like to be faced every day, year in and year out with a bunch of grinning, chattering young magpies firmly determined to resist all attempts to pound the rudiments of education into their dear little curly heads. You would have a legitimate excuse for grinding your teeth and stamping violently on the surface of the United States. The columnist also may have her tongue in her cheek when presenting her various bon mots. How would you like it if you had to grind out a column 800 or 900 words every day?"

"You have me there," Bill admitted. "How any human being can grind out a column every day is beyond my comprehension. If I answer a letter now and again I feel I am entitled to knock off and call it a day. And that reminds me I had an inquiry recently from a foreign foundryman. He wrote that in his foundry he makes water pipe connections, elbows, bends, T's, Y's, etc., in wide variety from 3 to 24 in. diam. Green sand molds are made on jolt-rollover machines. Green sand cores are made in two-part coreboxes. He would appreciate information on how these castings are made in American foundries."

"You may consider yourself fortunate," I said "Your correspondent might have asked you for a full, detailed description of the old oaken bucket with illustrations showing the well and the long counter-weighted pole with the bucket suspended from one end."

"Many years ago, when I had more ambition and curiosity than I have now, I took that old oaken bucket poem apart to see what made it tick. I have a copy of the document here some place. Want me to read it?"

"No," I assured him hastily. "One thing at a time is about all I can stand. What did you write to the citizen of a foreign land who inquired about American foundry practice on making cast iron pipe fittings?"

"I have a carbon copy which I shall be pleased to read if you can sit still for about seven minutes.

With occasional slight variation the following description covers American foundry practice in the production of gray iron castings grouped under the general classification of pipe fittings. Molds are made on jolt machines or under a sandslinger. Cast iron flasks follow the contour of the pattern and are designed to carry a minimum amount of sand. Joints are planed and lugs are fitted with pins and pin holes to insure accurate fit between cope and drag. Sand strips in cope and drag help to hold the sand in place. Bars in the drag elim-

AJAX-WYATT
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This line frequency induction furnace, so universally used in the wrought brass industry, is now, because of improved linings, available for melting ferrous alloys used in the foundry industry.

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Associate Companies:
AJAX *Electro Metallurgical Corporation*
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AJAX *Electric Co., Inc.*
AJAX *Engineering Corp.*

inate the need for bottom boards or plates.

Openings in the ends or sides of the flasks take the core prints and provide a means for anchoring the cores in place. The openings are large enough for the largest size casting within the capacity of the flask. If a smaller size is made in the same flask and if the core iron does not rest on the iron, a small wood block or wedge supports the core. When the size of the opening is greatly in excess of the size of the core print, a short piece of steel plate with a suitable semicircular opening keeps the sand in place. A simple similar device is placed between the extension to the core arbor and the upper edge of the semicircular opening in the cope. Flasks too heavy to be handled by hand are provided with trunnions on a center line to facilitate rolling with minimum effort.

For many castings two halves of a split pattern are mounted on boards. For certain types of symmetrical castings, one half pattern serves for cope and drag. The drag is rammed first and placed on the floor or on a conveyor line. The cope is rammed over the same half pattern, lifted from the machine, turned end for end or from side to side and placed on the drag. Obviously the most extreme accuracy is required in setting the pattern or patterns on the board so that the resulting casting or castings will not show a shift or fin along the joint line.

Green sand cores are made in hinged coreboxes. A cast iron arbor, made up of a substantial central member and a number of half disks spaced about 6 in. apart, is placed in the drag half of the corebox. Green sand is rammed in this box in the usual manner and scraped off flush with the edges. The second, or cope half of the corebox without any arbor is rammed full of sand and scraped off in the same manner. The two halves are turned up on edge and brought together as in closing a book. The entire corebox is turned back on the floor or bench with the drag underneath. The cope half of the corebox is rolled back out of the way and in readiness for the next core. The core is lifted out of the box and placed in the mold. Where withdrawal from the casting is straight and simple, the core arbor is in one piece. For T's Y's and some other shapes the arbor is in two or more sections held in place by a wedge or wedges at the junction point. When the wedges are knocked out, the arbor sections may be removed separately from the casting.

Set gates are attached to the pattern to form clean, smooth openings for the passage of the iron into the mold. As a further precaution in the production of clean castings, a dry sand pouring basin is placed on the cope with the opening at the bottom near one end immediately above the sprue. Metal from the ladle falls into a slight depression at one end of the basin, then rises and flows to the opposite end where it falls through a strainer core into the sprue.

Natural bonded sands are used in the molds and cores in some places. Other foundries equipped for handling large volume of sand mechanically, prefer a synthetic sand mixture. In at least one prominent plant the base is a washed silica sand bonded with bentonite. Physical properties include: Grain size 90, permeability 85, moisture 5 to 6 per cent, green compression 7 to 9 lb, dry compression 85 lb. Seacoal in the mixture amounts to 4 to 5 per cent.

All American Brass and Aluminum Foundry, 928 Portola Ave., Compton, Calif., has been formed by Robert Bryant and Thomas Turner, partners.

SAVE TIME

You can cut down the time for loading, unloading and moving hard to handle materials . . . and make a direct saving of hand labor. Whatever your job, STEARNS Lifting Magnets will help you save time and money.

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STEARNS Lifting Magnets are being successfully and profitably used in handling scrap iron, steel plates, coils, bundles, strip steel, rails, slabs, billets, pig iron, castings, borings, turnings as well as finished products. The problem of loading or unloading . . . or moving large quantities of material quickly at a low cost — easily solved with STEARNS Lifting Magnets.

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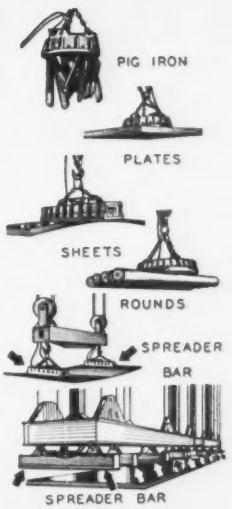


Standard sizes available in both bolted and all welded constructions. Special sizes and shapes made to your requirements.

Stearns MAGNETIC MANUFACTURING CO.

662 S. 28th ST., MILWAUKEE 46, WISC.

New EQUIPMENT *and Supplies*

For Additional Information on these Items Use Reply Card—Page 199

(1)—Die Casting: Miller-Taylor Tool Co., 5005 Euclid Ave., Cleveland—Closed hydraulic system using either soluble or nonflammable oil instead of hydraulic oil is said to eliminate fire hazards on the shot end of the company's improved die casting machines. Telescopic fluid transmission assemblies to hydraulic ejection die lock and shot cylinder have been substituted for hose and flexible piping on the new machines.

For More Details Circle No. 1—Page 199

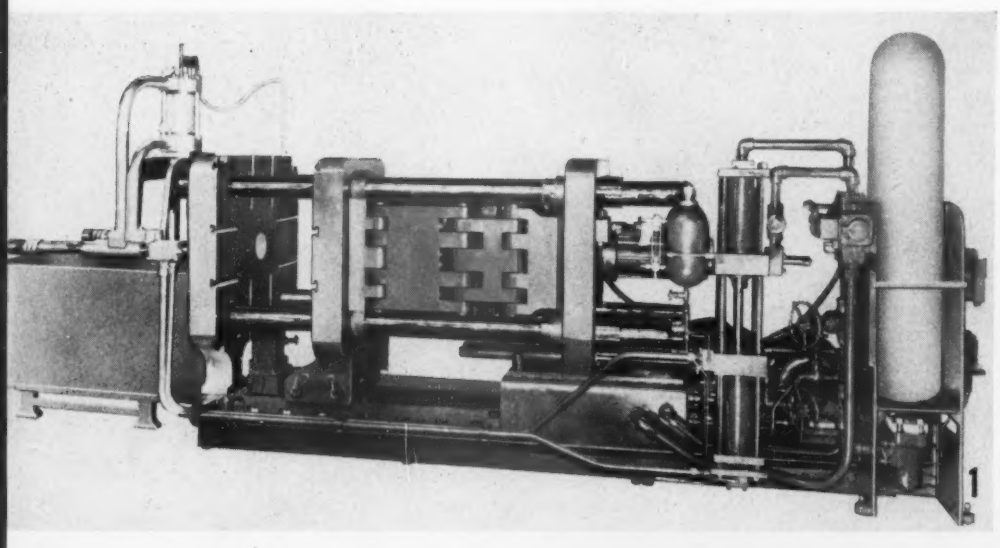
(2)—Fork Lift: Kwik-Mix Co., Port Washington, Wis.—Power driven fork lift attachment for the company's power wheelbarrow has a 1000-lb lift capacity and raises the load to a maximum height of 30 in. Forks tilt to the rear when being raised and are adjustable to a maximum width of 33 in. Standard forks are 20 in. long; 30-in. forks are optional. Total weight of machine and fork lift attachment is 1400 lb. A 4 hp gasoline engine furnishes power for forward and reverse travel of the machine and for lifting loads. Fork lift attachment is interchangeable with a 10 cu ft hopper, a 32 in. x 4 ft flatbed platform of 1200-lb load capacity, or a 5 ft scraper blade.

For More Details Circle No. 2—Page 199

(3)—Control Valve: Syntron Co., 540 Lexington Ave., Homer City, Pa.—New type valve for controlling flow of bulk materials from bins, hoppers, and chutes, and for free air control in heating, ventilating, and drying has a flexible diaphragm (made of cotton duck, nylon, rubber, or other material suitable to the application) which, in operation, is similar to the iris diaphragm of a camera, so that rotating the control lever increases or decreases the opening of the diaphragm and the flow of material. The fabric diaphragm is said to withstand many months of hard usage and may be replaced at low cost. The valves are available in five different sizes to fit openings up to 12 in. in diam.

For More Details Circle No. 3—Page 199

(4)—Cab Cooler: Dravo Corp. Air Conditioning Dept., Fifth & Liberty Aves., Pittsburgh 22—Equipment for air conditioning the cabs



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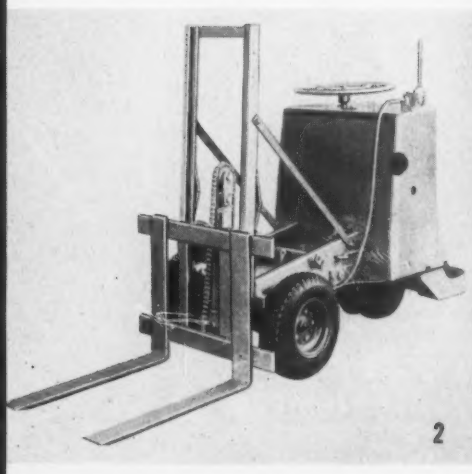

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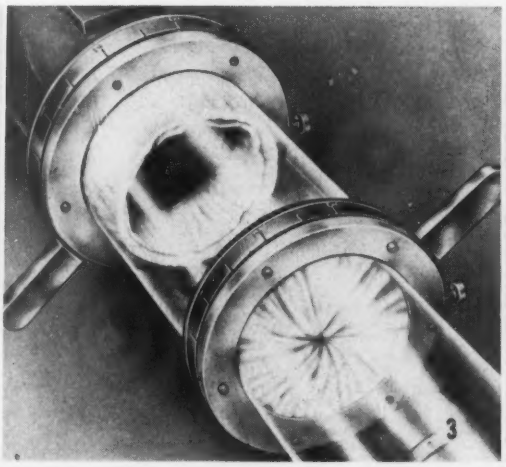

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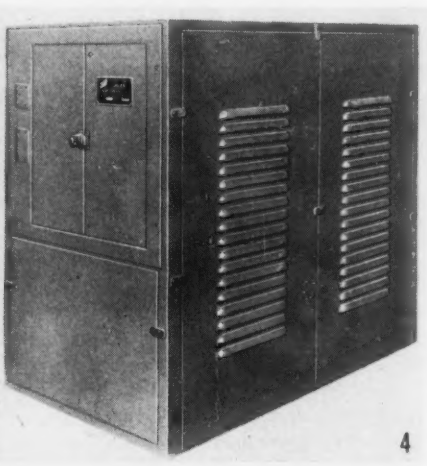

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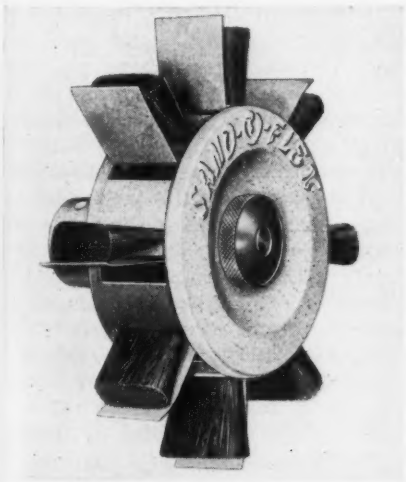
of cranes operating in high temperatures or in atmospheres contaminated by toxic and noxious gases or dusts, is known as the split type crane cab cooler because the cooling section is installed in the cab and the larger condenser section is placed outside on the crane in any convenient location. Unit provides constant, year-round ventilation, filters the air to remove dust, dirt and fumes, cools the air in the summer and, if necessary, heats the air during the winter. Thermostatically controlled, the cooler will maintain a temperature of 80 to 85°F when the outside temperature is 175°. Used as a heater the unit is said to keep cab temperature at 68 to 75°F with an outside temperature of zero.

For More Details Circle No. 4—Page 199

Pattern Coating: Foundry Rubber Inc., 4914 Bethesda Ave., Bethesda, Md.—Plastic wood finish is said to provide a long-wearing, protective coating for foundry patterns, particularly in sandslinger and air-blown operations. Additional claims are that it can be brushed, sprayed or dipped, and dries to a tough, hard, abrasion-resistant finish that retains its smooth, high-gloss, flexible surface under adverse conditions. About two-thirds the hardness of plate glass, the material is moistureproof, scratch-proof and resistant to chemicals and materials used in core binders and sand mixes. It does not soften or become sticky or tacky at any temperature and breaks down only around 600° F.

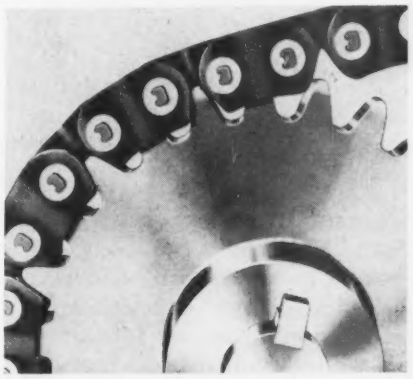
For More Details Circle No. 5—Page 199

Sand Wheel: Merit Products Inc., 4023 Irving Pl., Culver City, Calif.—Improved sanding wheel model is a brush-backed device that may be attached to any rotating shaft for sanding and finishing curved and contoured surfaces. Unit has eight replaceable brushes fastened to its perimeter. Brushes back up and "cushion" eight strands of abrasive cloth, 1 in. wide, which unwind from a single core. As the wheel rotates, the abrasive strips mold to the contour of the work piece. Wood, metals, compositions—any material—may be sanded. As abrasive wears, it is cut or torn off and new abrasive is fed from the central magazine. Lighter weight than a former model, it is recommended for use on portable electric drills and flexible shafts.



For More Details Circle No. 6—Page 199

Power Transmission: Morse Chain Co., 7601 Central Ave., Detroit 8—New power transmission chain drive is designed to provide a power transmitting medium that combines the ruggedness and dependability of a gear drive with the smoothness and lack of vibration of a belt. Single drive units have transmitted as much as 5000 hp at linear speeds up to 6500 fpm, or rotative speeds up to 3600 rpm. A 2-in. wide drive has transmitted as much as 500



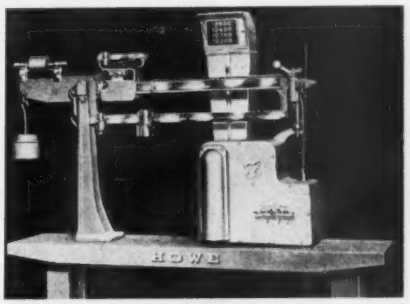
hp. It is said the new power transmission drive will permit development of small and inexpensive power plants which produce high horsepower due to the high speeds which can be handled. The drive is designed specifically for speed applications higher than conventional chain drives. It is said to run cool at all speeds and with an efficiency of over 99.5 per cent. Its efficiency contributes to lower power transmission costs in existing single motor or engine installations of 100 hp and up, it is claimed.

For More Details Circle No. 7—Page 199

Sand Additive: Delta Oil Products Co., Milwaukee 9—Sand release agent for use in both molding and core sand mixes is said to improve flowability and workability of the sand mix, and prevent sand from sticking to coreboxes, patterns, hoppers and conveyors. The product is used in the ratio of 8 oz per ton of sand and is added with the water to facilitate its distribution throughout the mix. In system sand the addition after the first application is reduced sufficiently—3 or 4 oz—to maintain proper flowability and workability.

For More Details Circle No. 8—Page 199

Scale Accessory: Howe Scale Co., Strongs Ave., Rutland, Vt.—Weighing accessory is designed to be attached to any beam scale, or to



any scale convertible to beam operation making a beam scale an "automatic" of the latest type. Unit is attached to the beam shelf and connected to the beam with a rod. It features a nonprotruding periscope which flashes the exact weight in large, illuminated figures on a mirror-type screen. An oil dash-pot dampens the up and down movement of the beam, resulting in an image on the screen that comes to a stop quickly for easy and instant reading.

For More Details Circle No. 9—Page 199

Core Wash: United States Graphite Co., 1621 Holland St., Saginaw, Mich.—New core wash is said to possess nonfermenting properties with consequent elimination of sour core washes and resultant gas bubbles that cause pock marks on drying. It is a thin, high temperature coating that provides good surface smoothness and is said not to build up or run on core surfaces. The core wash penetrates the sand and anchors firmly to the core, giving protection in depth that prevents burn-in and remains intact as the molten metal churns by, it is claimed. Highly refractory, it provides effective insulation at the sand-metal interface and resists penetration by the fluid metal.

For More Details Circle No. 10—Page 199

Lift Trucks: Yale & Towne Mfg. Co., Philadelphia Division, 11000 Roosevelt Blvd., Philadelphia 15—Light capacity electric fork lift trucks, offered in capacities up to 2000 lb, feature simplified automotive-type controls, hydraulic lift, and compact size. Other features include a magnetic contactor control designed to prevent severe loads on the motor. There is a time delay between speeds for smooth, uniform acceleration, preventing jack-rabbit starts

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Electro High Speed Grinding Wheels Save Dollars in Grinding Malleable Iron

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The improved grain-holding resin bond in Electro High Speed Grinding Wheels, engineered to the job in hand, are two reasons for efficiencies 45% above competitive wheels. • Operating results show: 153 lbs. of metal removed while competitive wheels averaged only 105 lbs. under identical conditions. In grinding from 24" to 20" diameter Electro removed 6.8 lbs. of metal per cubic inch of wheel and 10.4 lbs. per hour. • Here's a 45% saving which holds regardless of size of annealed malleable castings. Comparable records apply to this and all other Electro wheels. • All we ask is opportunity to prove Electro's higher efficiencies in your plant on your work. No obligation. Write, phone or wire.

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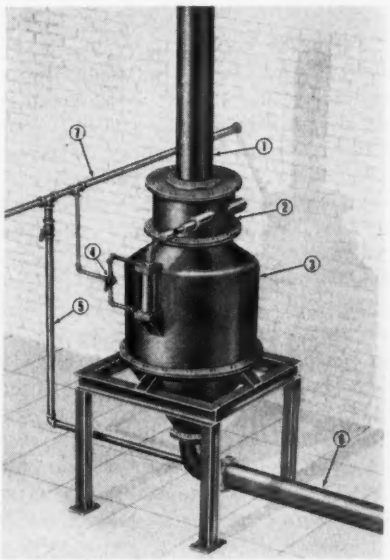
that might shift and damage loads. Nonplugging device on the electric controller prevents reversal of power in any but first speeds. Hydraulic brakes provide smooth stops with no braking through the gear train.

For More Details Circle No. 11—Page 199

Conveyor: Brady Conveyors Corp., 20 West Jackson Blvd., Chicago 4—Pneumatic conveyor system is designed to move bulk material wherever a pipe line can be run regardless of the distance or the number of bends in the line. Delivery can be made to any number of receiving points. Basic unit in the system is illustrated here. Material enters at (1) through gate (2) to the pressure vessel (3) where the material is air activated, creating a fluent mixture of



the air and solids. Material flows through a pipeline (6) just as a fluid would flow under pressure to the receiving points. Part (4) is a hand or remote control operated air cylinder for closing gate when the pressure vessel (3) is filled. Pipes (5) and (7) supply air at points necessary to aerate and fluidize material.

For More Details Circle No. 12—Page 199

Intrusion Alarm: Photoswitch Inc., 77 Broadway, Cambridge 42, Mass.—Photoelectric alarm provides a protecting wall of invisible light across any space up to 50 ft. No intruder can enter this space without setting off the alarm. Set consists of a photoelectric control and a light source which projects an invisible infrared beam aligned to strike the "eye" of the control. Momentary interruption of the infrared beam actuates the control relay, which is wired to operate and sustain an external alarm device. Alarm can be silenced only by restoring the electrical circuit to original conditions by use of

(*Continued on page* 202)

IDEAS for FOUNDRYMEN

AVAILABLE FOR THE ASKING—This reader-service is designed to provide foundrymen with "idea" and reference material. Listings are selected from company product literature and reprints of special FOUNDRY editorial articles.

50. Safety Kits

Towmotor Corp.—Prepared in clear bright colors with large type face to emphasize their safety message, interior plant signs caution truck operators of "Blind Corners", "Traffic Crossings", "Low Head Room", etc. Four posters are included in set and employ cartoon approach to remind operators of some element of safe fork lift truck operation.

51. Grinding Problems Answered

Mall Tool Co. has a new slant in answering questions in their new catalog No. 20 about flexible shaft equipment, motor weight, which machine is suitable for which job, the attachments to be used and general information on company's line of grinders. Swell addition to anybody's file!

52. Core Binders

Hercules Powder Co. offers attractive booklet on their Truline binder. Instructions for use of various types of cores together with tables for mixing guide are given. Excellent information and very useful for your core room foreman. Formulas for steel, gray iron, malleable and nonferrous work. Ask for this number.

53. For Nonferrous Melting

Just the right sizes and types of gas-fired crucible furnaces for handling most nonferrous metal melting operations are listed in 8-page illustrated bulletin C-2. Eclipse Fuel Engineering Co. describes models with brass capacities ranging to 1250 lb and aluminum to 1100 lb.

54. Truck Casters & Wheels

Divine Brothers Co.—44-page illustrated catalog No. 25 lists various types of truck casters for light, medium and extremely heavy-duty application; industrial truck wheels including canvas cushion, Formica molded, vulcanized rubber and steel forged types; and helpful data relative to selecting and ordering wheels and casters.

55. Scales & More Scales

Toledo Scale Co. makes a scale to meet practically any weighing problem encountered in foundries. Typical scales and applications are pictured in 32-page illustrated broadside "Better Ways." Units designed to facilitate weighing, testing, measuring and controlling materials and products are described in detail.

56. Fast Core Blowing

Redford Iron & Equipment Co. reports that their No. 2 stationary magazine type core blower is the fastest and most versatile unit on the market. It's a complete core making station. All you have to do is connect it to an air line and you're ready to make cores. Eight outstanding features are outlined in 4-page bulletin.

57. Fork Lift Truck

Kwik-Mix Co.—How low cost Moto-Bug power driven fork lift truck speeds material handling is described and shown in 2-page illustrated bulletin KM 315. Truck has 1000-lb capacity, 30-in. lift, power driven hydraulic pump, adjustable forks and interchangeable hopper and platform bodies.

58. Weighing Equipment

Richardson Scale Co.—Proportioning, blending and process control equipment for efficient materials handling by weight are depicted and described in 4-page illustrated bulletin No. 0550. Applications for this equipment include preparing sand and core binder for foundries.

59. Too Hot To Handle?

Imperial Belting Co. — Standard Sahara conveyor belting will carry materials as hot as 300° F safely, but where sustained temperature of materials exceeds 300° F, you can use Insulated Sahara belting. Both are described in data sheets 47-8 which are yours for the asking.

60. Flooring That's Hard

Walter Maguire Co.—8-page illustrated bulletin No. 651 presents advantages and various applications of Emeri-Crete heavy duty, nonskid, nonabsorbent and economical concrete industrial flooring made with Cortland emery aggregate.

61. Core Oil

Archer-Daniels-Midland Co. — Bulletin No. 108 outlines characteristics of Inductol prebaked core oil for faster baking, added green strength and good collapsibility.

Additional Information?

For additional information on any of the items described under "New Equipment and Supplies," "Trade Publications" or "Helpful Literature" in this issue—simply circle corresponding item numbers on one of these cards

7-51

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Penton Building, Cleveland 13, Ohio

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62. This Truck Is a Workhorse

Erickson Power Lift Trucks Inc.—8-page illustrated brochure gives specifications for platform, fork and custom-built Erickson industrial trucks and accessories. Latter includes fork side-shifter, auxiliary transmission with four speeds, forward and reverse. All basic models can be modified to conform with individual requirements.

63. Ready-To-Use Refractory

Plibrico Jointless Firebrick Co. — Pliosil, supplied as moist plastic ready for immediate application, is highly resistant to metal penetration and slag adherence. It's ideal for lining ladles, runners and spouts. You can patch cupolas, too. Directions for using and amounts needed for specific jobs are given in 4-page data sheet No. 5.

64. Impregnating Process

Metallizing Co. of America—8-page illustrated bulletin "Mogul Cast-Seal Impregnating Process" explains how this method and related equipment yields positive low-cost means of eliminating casting porosity.

65. Barrow Holds a Lot

American Conveyor Co.—This illustrated data sheet has details of model G-12 and D-12 Speed-Barrows which have 12 cu ft capacity and handle as easily as baby buggy, even when loaded. First model has discharge gate tripped by bar, while second is dumped by tipping forward.

66. Industrial Brushes

Pittsburgh Plate Glass Co.—32-page illustrated brochure presents 12 examples of how company's industrial brushes save industry money and time. Examples cited include cleaning welds, finishing stainless steel sheets, removing sand from hot cast iron and removing burrs from steel.

67. Ram With Air

Dayton Pneumatic Tool Co. lists type of ramming work which can be done easily and efficiently with various sizes and types of Ring Valve rammers. They operate directly on shop compressed air line. Ask for bulletin 300.

68. Scoop Loader

Butler Bin Co.—Designed for factory yard work as well as for platform, box car and floor use, 'butler 102' scoop loader has 1000-lb capacity 12-cu ft bucket and handles just about everything including metal scrap, cement, gypsum, sand, copper concentrate, ingots, coal, castings and ore. Various applications, features and specifications are listed in 6-page illustrated bulletin No. 250-B.

69. For Your Pattern Shop

Oliver Machinery Co. — The No. 299 single-surface planer described in new 4-page illustrated bulletin will handle surfaces up to 24 in. wide on wood up to 8 in. thick at speeds from 18 to 40 ft per min. Pieces as short as 11 in. will feed through one at a time.

70. Get Sound Castings

Atlantic Chemicals & Metals Co.—Ways to solve your melting problems are offered in 8-page illustrated bulletin "Immunitas Products" which tells how to use specific fluxes for casting, smelting or refining aluminum, brass and bronze, nickel-based alloys, zinc and zinc-based alloys, tin-lead alloys, and iron and steel.

71. Boiler Settings

Ironton Fire Brick Co.—Monolithic boiler settings and industrial furnace linings such as Nojoint plastic refractory are discussed in 4-page illustrated bulletin No. 100. Suitable for rammed-in walls and baffles of boiler furnaces, monolithic linings eliminate joint failures, spalling in arches and flame erosion of sidewalls.

72. No More Moisture

Jas. A. Murphy & Co.—This illustrated folder is a collection of catalog sheets on Murphy products intended to banish moisture from compressed air. Included are aftercooler separator filter, aftercooler system, drop line separators, ball float traps, inverted bucket trap, Shar air regulator and other equipment.

IMPORTANT READING FOR FOUNDRYMEN
We have a limited quantity of the following reprints which we can furnish while they last.

73. Mechanized Foundry

Pat Dwyer writes one of his famous articles from the real "foundryman" viewpoint on production of castings in a modern foundry. Even one little idea you might get from this story could be the means of greater production and greater economy of operation. While they last!

74. Doubles Production

"Careful planning and efficient operation have boosted production of gray iron farm implement castings over 100 per cent" are the opening words of a reprint of an article in a recent issue of FOUNDRY. There just might be an idea or two that you could adapt to your own foundry. Reprints available while they last.

75. Cleaning Dept. Handling

Reprint of a story in FOUNDRY which might save you a lot of hidden expense when it comes to most efficient operation of your cleaning room. Well illustrated in 11 pages. Get this one!

76. Effect of Oxygen

Causes of excessive amounts of iron oxide in gray and malleable iron castings and their influence on microstructure and other properties are described in this outstanding article, a reprint from FOUNDRY. The author also covers deoxidation methods, with particular reference to silicon carbide additions to the cupola. They're going—going!

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7	19	31	43	55	67	79	91	103	115
8	20	32	44	56	68	80	92	104	116
9	21	33	45	57	69	81	93	105	117
10	22	34	46	58	70	82	94	106	118
11	23	35	47	59	71	83	95	107	119
12	24	36	48	60	72	84	96	108	120

FOUNDRY
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7-51

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How to "snag" a production record

B5 and B7N resinoid bond snagging wheels by CARBORUNDUM are setting production records in foundry cleaning rooms by turning out a high volume at low unit cost. A high cutting rate is maintained throughout wheel life. Increased safety is a result of greater wheel strength. Available in all sizes for stand, swing frame and portable grinders. See your CARBORUNDUM representative, or write Dept. F 81-23.

Only CARBORUNDUM
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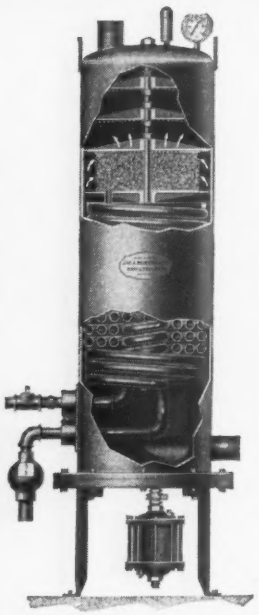
"Carborundum" and "Aloxite" are registered trademarks which indicate manufacture by The Carborundum Company, Niagara Falls, N.Y.

makes ALL Abrasive Products ...to give you the proper ONE

81-23



LET MURPHY AFTERCOOLERS DRY CLEAN YOUR COMPRESSED AIR

and give it a chance to function at full efficiency. If compressed air is dirty, warm or wet, two unfortunate things happen for sure: "down time" increases, and repair costs mount. The MURPHY A.S.F. (Aftercooler-Separator-Filter) guarantees the delivery of cool, dry, clean air to the point of use. It is completely automatic, and requires neither attention nor maintenance. It is built in 1" to 6" pipe sizes and for capacities of 50 to 2,000 CFFAPM. Every unit carries a money-back guarantee.

AFTERCOOLERS, STRAINERS, SEPARATORS, TRAPS.

We specialize in the manufacture of equipment to clean compressed air. Our pipeline aftercoolers are bringing wonderful results every day in prominent companies all over the country. This MURPHY TYPE A SEPARATOR, employing 4 positive principles of separation, is a typical money saver. All users of compressed air will be interested in these units, as well as in our strainers and traps. We invite inquiries.

MURPHY PISTOL SPRAYER

WRITE FOR DESCRIPTIVE LITERATURE

PRICES COMPLETE WITH SUCTION HOSE AND SINKER

PIPE SIZE	1/16"	1/8"	1/4"	3/8"	1/2"
PRICE F. O. B. HAMILTON, O.	$12.00	$12.00	$12.00	$14.50	$18.00

Used for Silica wash, oil, water or any liquid material. For sand-blast cleaning. As a blow gun for cleaning motors and machinery. If your dealer cannot supply you at once, order direct from manufacturer below. Literature on request.

GUARANTEED COMPRESSED AIR PRODUCTS

AFTERCOOLERS • SEPARATORS • STRAINERS • TRAPS
SPRAY GUNS • PISTOL SPRAYERS

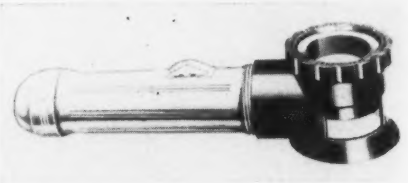
JAS. A. MURPHY & CO.
FIFTH AND VINE STREETS, HAMILTON, OHIO
Moisture Elimination Up To 3000 Pounds Per Square Inch

(*Continued from page* 198)

a manual or automatic reset switch. Sensitivity adjustment on the control permits positive operation over varying distances between the control and light source, and under all conditions of ambient light.

For More Details Circle No. 13—Page 199

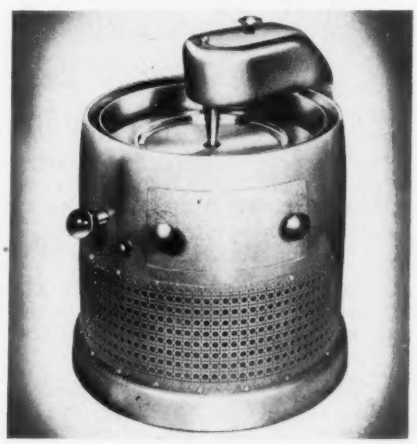
Magnifier: Abbeon Supply Co., 58-10 41st Dr., Woodside, N. Y.—Illustrated instrument combines a 7-power magnifying glass with built-in light that illuminates the magni-



fied field of vision without throwing direct rays in the user's eyes. Lens is said to give a clear, flat field of vision with low distortion and aberration. Unit is about 1 in. longer than a standard two-cell flashlight, and standard dry cells are used for the light. Other units can be supplied for 5-power, 20-power and 40-power magnification.

For More Details Circle No. 14—Page 199

Classifier: Harry W. Dietert Co., 9330 Roselawn Ave., Detroit 4—Particle classifier is designed to separate mixed particles into eight fractions from 0 to 60 microns plus oversize residue in two hours. It may be applied to any type of material, and the sample may be as small as 10 grams. Gentle air sorting preserves



individual particle size while making sharp divisions in grading, it is claimed. All parts of the classifier in contact with the sample are stainless and may be kept clean and sterile.

For More Details Circle No. 15—Page 199

Air Valves: Wilkerson Corp., 1749 South Broadway, Denver—Line of valves is designed for automatic

(*Continued on page* 204)

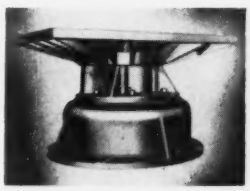
PLAY SAFE!

WITH DAVENPORT MOLDING MACHINES

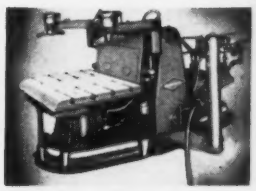
YES, PLAY SAFE—

with dependable, proven mechanized equipment. For over forty years, DAVENPORT molding machines have served the leading foundries of America. You can be assured of dependable production results with DAVENPORT. Lower your costs—improve your quality—deliver uniform castings with DAVENPORT molding machines.

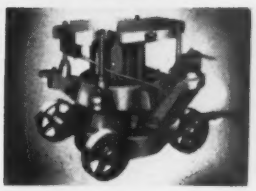
Write today for our complete catalog. You will be safe with DAVENPORT.



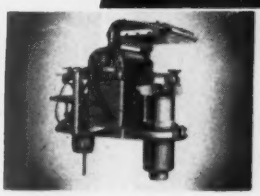
Plain Jolt
Model AJ-16



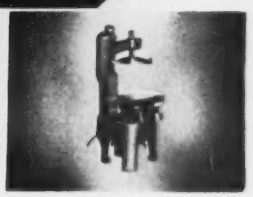
Jolt Rollover Draw
Model SA



Jolt Pin Lift
Model AJS (Portable)



Jolt Rollover Draw
Model A



Jolt Squeeze
Model 10-JX (Stationary)

DAVENPORT MACHINE AND *Foundry Company*

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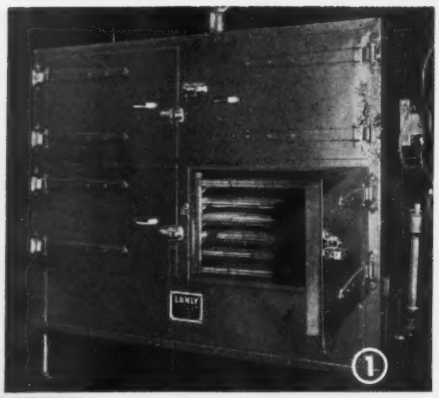
Fig. 1—A Lanly Shelf Type Core Oven is heated by burners directly under the work chamber. Available in several standard sizes.

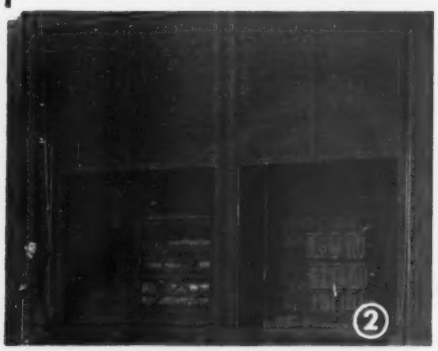
Fig. 2—A Two Compartment Car Type Mold Drying Oven. Each Compartment individually heated and controlled.



LANLY
CORE AND MOLD OVENS
meet drying needs of all foundries
LARGE OR SMALL

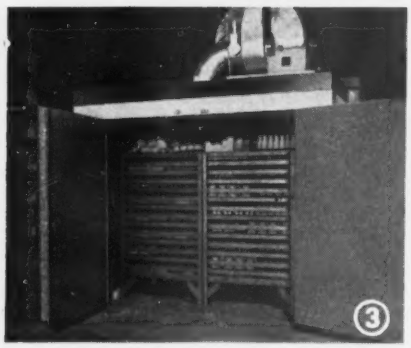
Fig. 3 — A Rack Type Oven which accommodates two racks side by side with a single set of doors.

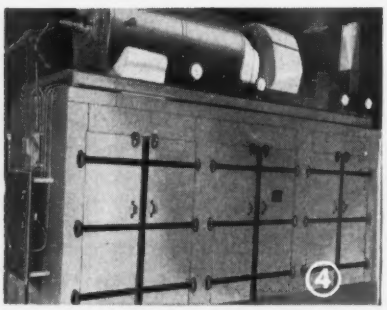
Fig. 4 — Three Compartment Rack Type Oven with quick change-over combination gas burner equipment.



WHETHER your particular requirements concern core baking, pasting and mold drying, or ovens and air draw furnaces for casting conditioning and heat treating, the Lanly organization of experts is well qualified to serve you.

If a Lanly standard unit does not fit into your picture, we'll design and build one that will. Write for the Catalog.





THE LANLY CO.
OVENS FOR INDUSTRY
HEATED BY GAS, OIL, ELECTRICITY OR STEAM
780 PROSPECT AVENUE CLEVELAND, OHIO

(*Continued from page* 202)

removal of contaminants and precipitates from compressed air lines, aftercoolers, sumps, tanks and air brake systems. When air line is not in use a diaphragm in the valve is forced down by back pressure with an O-ring sealing the sump bottom. As air is used the pressure differential raises diaphragm and shaft, seals bottom of middle chamber, opens bottom of sump and blasts out contamination.

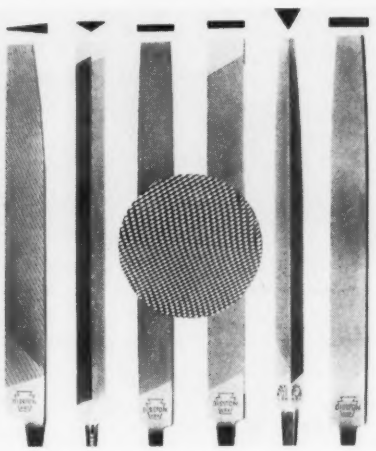
For More Details Circle No. 16—Page 199

Dump Truck: Kalamazoo Mfg. Co., Kalamazoo 24F, Mich.—Dump truck equipped with a 13-hp 2-cylinder, air cooled engine has three

forward and reverse speeds and a capacity of 2/3-yd or 300 lb. Steel dump body is standard equipment. However, an interchangeable steel platform body also is available. Newest improvement on the dump body is a manually operated dump control on the front end gate. This control door allows easier pouring into small or narrow openings and also is desirable for discharging partial loads.

For More Details Circle No. 17—Page 199

Files: Henry Disston & Sons Inc., Unruh & Milnor Sts., Philadelphia 33 —The staggered tooth principle has has been extended to the company's



entire line of double-cut files. Staggered tooth design is said to permit files to be operated on the principle

(*Continued on page* 206)

Leading the Field for 40 Years!

These two DEMMLER Core Blowers — a No. 2 in foreground and a No. 1 in background, owned by the Hills-McCanna Company of Chicago — are being used to blow cores that will be used in magnesium castings.

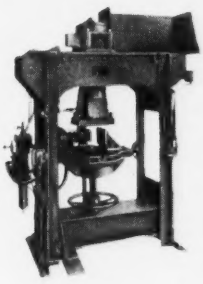
to be a favorite— earn the right!

This has been the opinion at DEMMLER'S since the company began building core blowers in 1911. And, through the years DEMMLER Core Blowers have enjoyed a popularity seldom achieved by any product.

DEMMLER Core Blowers have consistently proved their worth through "on the job" performance, producing better cores, faster at less cost.

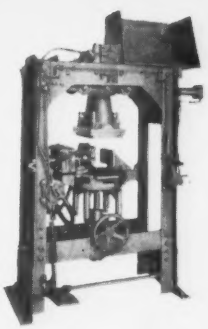
Little wonder, then, that they have enjoyed such wide acceptance for over 40 years!

Little wonder that Foundrymen have come to expect outstanding performance and matchless quality from every core blower bearing the familiar DEMMLER name!



No. 2 DEMMLER CORE BLOWER

Ideal for a wide range of core work. There is none better for core work required for pipe fittings up to 3" size, automobile malleable and grey iron castings, agricultural machinery castings and similar work. The DEMMLER No. 2 has substantial, sturdy structural steel frame; diaphragm type blow valve to produce a sharp blow. Clamping, blowing and exhaust operations are controlled by a foot operated slide valve. Table height and chuck jaw width adjustment regulated by smoothly operating hand wheels. Vertical core box clamp — 12" cylinder; horizontal core box clamp — 6" x 12" diaphragm. The No. 2 DEMMLER Core Blowing Machine is the wise choice of those who want to produce quality cores at a high rate of speed and with maximum economy.



No. 1 DEMMLER CORE BLOWER

Well known and liked by foundrymen is the DEMMLER No. 1, at left. This is a general purpose machine for blowing cores weighing up to eight pounds, such as plumbing goods, electrical fittings up to 1½", and various small brass malleable and grey iron castings. The No. 1 possesses quick job changing features. Chuck table is raised and lowered by a hand wheel. Chuck jaws are easily adjusted for different core box widths. Will blow either horizontally or vertically split core boxes. Different size sand magazines available. Capacity: approximately 200 core boxes per hour. Many have been in continuous, profitable use for more than 25 years with only minor repairs!

DEMMLER

WM. DEMMLER & BROS., KEWANEE, ILLINOIS

Manufacturers of Core Blowers Exclusively Since 1911

BETTER CASTINGS . . . from BETTER CORES . . . from BETTER CORE OIL

(Just Like the House that Jack Built!)

Users of **PELRON** Core Oils report

- Smooth Castings – Less Finishing
- Increased Production – Quicker Baking at Lower Temperature – Time, Space and Fuel Costs Cut
- Higher Green and Baked Strength
- Easier Shake-Out
- Easy to Handle in Blown or Hand-rammed Core Boxes

Check with PELRON

when core oil, core washes, and moistening agents are under consideration. We're always "looking for trouble"—looking for chances to help our customers lick their problems, build up our fund of knowledge and experience, fit ourselves to serve the Foundry Industry better, with improved products and methods.

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CORPORATION

7740 W. 47TH ST. LYONS, ILLINOIS

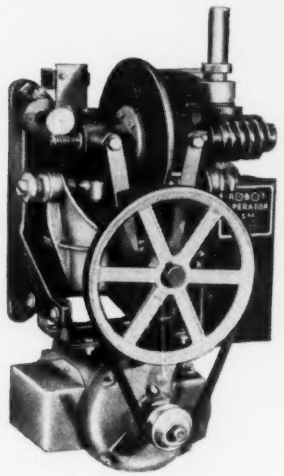
CHICAGO • DETROIT • CLEVELAND • BUFFALO • SOUTH BEND
INDIANAPOLIS • MILWAUKEE • ROCK ISLAND

(Continued from page 204)

of cutting rather than scraping. Overlapping teeth give a smooth cut; undercut teeth result in faster removal of chips; and the open gullets give long life to the files, it is claimed.

For More Details Circle No. 18—Page 199

Power Unit: Robot Appliances Inc., 13165 Prospect Ave., Dearborn, Mich.—Automatic electric power unit is designed to open or close, lift or lower, or rotate any object by electrical or magnetic remote controls. One such application is that of opening or closing doors and gates. Output shaft speeds range from less than 1 rpm to 200 rpm, and provision can be made for continuous, intermittent, or jog cycle operation in one direc-



tion or reversing cycle. Power source may be from electric motors of 6 to 220 v, single phase to ½-hp ac or dc; three-phase applications to 600 v, or vee belt drive from outside power source.

For More Details Circle No. 19—Page 199

Radial Saw: Skilsaw Inc., 5033 Elston Ave., Chicago 30—Radial saw is designed to bevel, miter, rip, dado, plough, and rabbet. Available with either manual or magnet controls, the saw features convenient adjustment handles and special stops which automatically set saw at more common cutting angles. Saw is made in a variety of voltage, horsepower, and motor cycle specifications with either 14 or 16-in. blades. Work table is 11¼-in. deep and may be increased to 13¼ in. if desired. Bearings are said to be easily realigned to within 1/100-in., giving constant accuracy for the life of the machine.

For More Details Circle No. 20—Page 199

Pyrometer Controls: Assembly Products Inc., Main at Bell St., Chagrin Falls, O.—Meters on new pyrometer controls have been increased

(Continued on page 208)

American Chain & Cable Co., Inc., Reading, Pa.

THIS company has devoted a half-century to the building of a reputation for high quality work. It is one of the pioneer producers of pressure castings.

Through the years its foundry techniques have kept pace with increased industrial demands for high strength and more dependable carbon and alloy steel and iron castings.

It is known as a good place to work because of its insistence on complete metallurgical control, good housekeeping programs, maximum use of modern materials handling equipment and overhead conveyors, and constant safety measures. Electric furnace melting, gamma-ray and magnaflux inspection equipment are used throughout the plant.

Herman Molding Machines, like the 1500 lb. series machine illustrated, assist American Chain in its efforts to be a good place to work. They are simple to operate, one rotary valve handle controlling all operations; dependable; pressure lubricated; AND all Hermans everywhere have made their way by the way they're made.

Herman **MOLDING MACHINES**

HERMAN PNEUMATIC MACHINE CO., UNION BANK BUILDING, PITTSBURGH, PA.

(*Continued from page* 206)

to 4½ in. to give better readability and improved appearance. They can be set to the control temperature with more ease and greater accuracy and can be read at a greater distance than meters on previous models. Other improvements include heavier steel panels and cabinets. Reinforced corners and three point suspension prevent pulling the cabinet out of shape when it is screwed down on an uneven surface. Plug-in connections between control and terminal board facilitate removing or replacing the unit without disturbing any of the permanent connections. Instruments may be used for automatic on-and-off control to maintain a preset temperature or as a shut off device or safety warning unit which will make contact when a preset temperature is reached, to sound an alarm or shut off a furnace.

For More Details Circle No. 21—Page 199

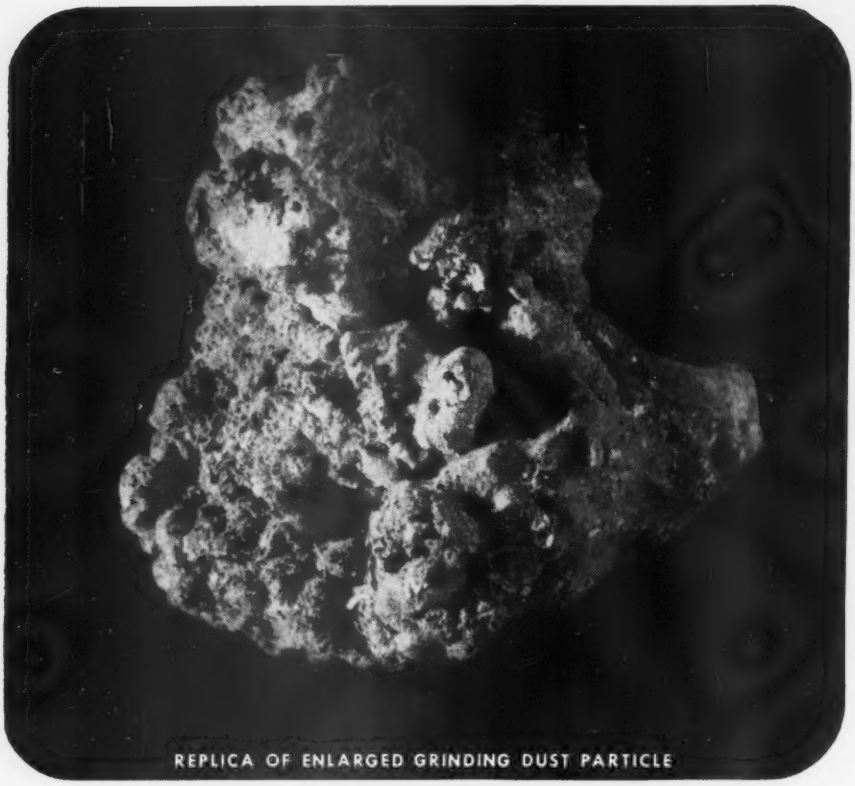
Conveyor: Mathews Conveyer Corp., Ellwood City, Pa.—Portable eastern type belt conveyor (10 ft long, 12 in. wide) is adjustable from

level to approximately 30 degrees of incline. It is adjustable at both ends by a crank, with a minimum elevation of 9 in. and a maximum discharge elevation of 6 ft, 6 in.

For More Details Circle No. 22—Page 199

Load Cells: Baldwin-Lima-Hamilton Corp., Philadelphia 42—Load cells for measuring forces in tension have capacities of 10,000, 20,000, 50,000 and 100,000 lb. Load measurement is based on the use of special resistance wire strain gages bonded to a load-carrying shaft. The gages respond to infinitesimal stretch of the shaft under tensional load by a change in electrical resistance that varies the voltage. This change of voltage is measurable on a direct-reading dial indicator or a recorder of either the resistance potentiometer

(*Concluded on page* 210)



REPLICA OF ENLARGED GRINDING DUST PARTICLE

TROUBLE—MAGNIFIED 3000 TIMES!

Ever wonder why some machines require excessive maintenance? Why they are not as accurate in performance as they are rated?

One vital answer is *abrasive* dust. When uncontrolled, it can attack bearings and other precision machine parts with damaging effects—creating abnormal wear and "sloppy" operation. In addition, safety engineers have long recognized the hazards of abrasive dusts to workmen.

Uncontrolled dust of any type in manufacturing or processing not only is troublesome but becomes a costly problem by reducing operating efficiency of both men and machines.

DRACCO DUST CONTROL EQUIPMENT—backed by over 35 years engineering and manufacturing experience exclusively in dust control—can remove this hazard from your operations. DRACCO engineers will gladly provide you with complete data on high-efficiency DRACCO equipment as applied to your specific problem. Simply write to

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415 Lexington Avenue, New York 17, N. Y.

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DRACCO *Performance Proved*
DUST CONTROL EQUIPMENT
PNEUMATIC CONVEYORS • METAL FABRICATION

You may be missing a chance for real savings on refractory costs—

if your men haven't yet tried rammed-in ladle linings of IRONTON BERLITE

Five to forty times longer service from your ladle linings . . . that's what you ought to be getting. That's what *Ironton* BERLITE is delivering now in hundreds of foundries. This super quality, special purpose refractory material is built for times like these. You will see your operating expense go down . . . production rates go up . . . when *Ironton* BERLITE cuts repair and downtime, keeps ladles working longer at a lower cost per ton of metal handled, and gives you cleaner castings.

A wartime development, *Ironton* BERLITE meets severe operating conditions with these points you want in a refractory lining:

- **UNUSUALLY HIGH REFRACTORINESS**
- **EXCELLENT WORKABILITY AS MORTAR, MUD OR RAMMING MATERIAL**
- **HIGH STRENGTH**
- **EXCEPTIONAL RESISTANCE TO SLAG EROSION**
- **NO SHRINKAGE**
- **NO PEELING OR BLOATING**

Use versatile *Ironton* BERLITE as a bonding mortar and wash for brick-lined ladles, and as a mud or rammed lining for hand, bull, and transfer ladles. Ferrous and non-ferrous operations show real savings with *Ironton* BERLITE. This easy-working refractory comes in handy around the cupola, too.

GET Ironton's Bulletin 411 on BERLITE, or call the Ironton representative nearest you. Phone numbers are listed at the right. Our field men can show you Ironton-approved ways of making BERLITE do all that we say it will do in your foundry.

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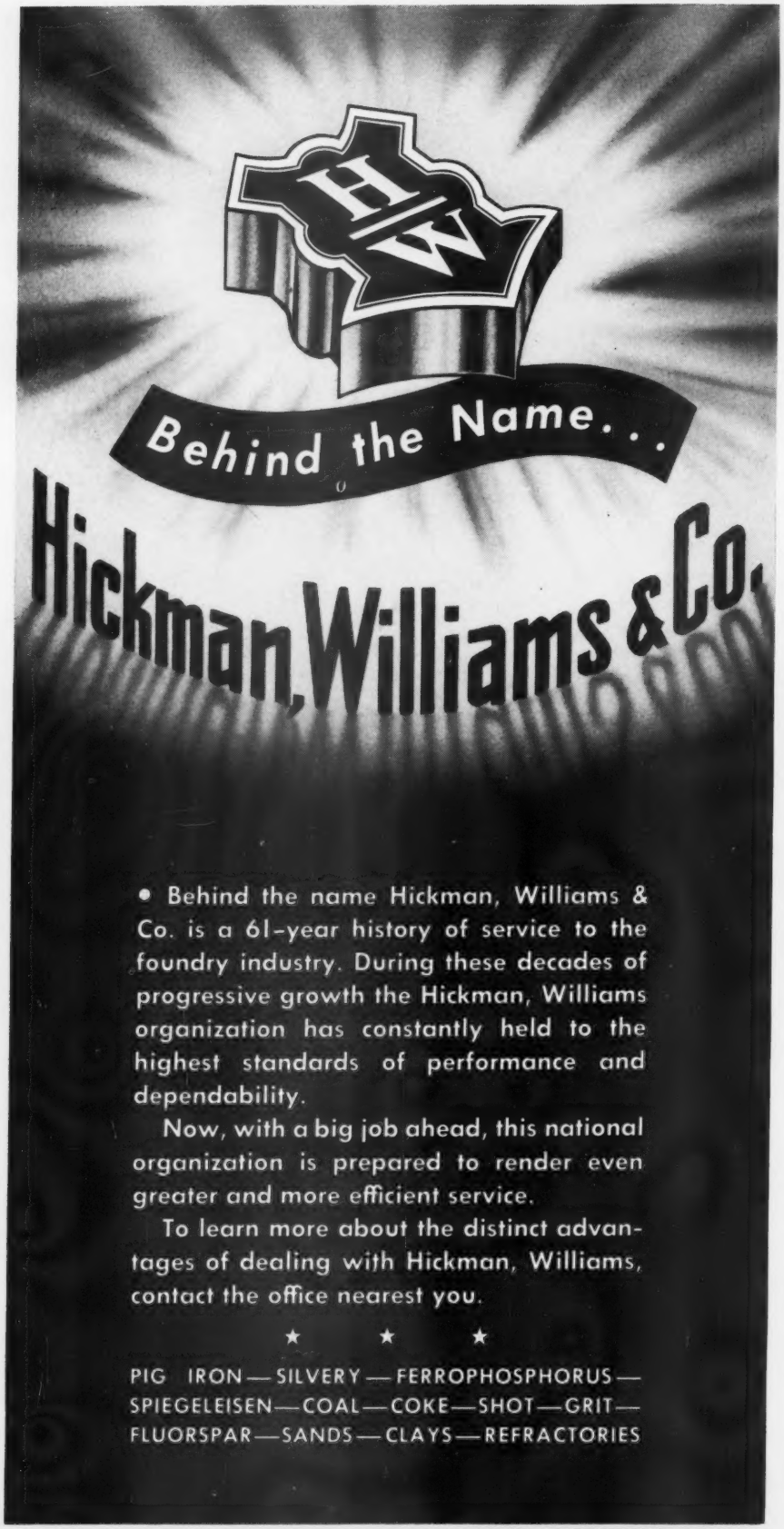
THE IRONTON FIRE BRICK COMPANY
IRONTON, OHIO

BERLITE • ALSET
CARO-LINE • NOJOINT • SPECIAL SHAPE REFRACTORIES
KENTUCKY CLAY FIRE BRICK PRODUCTS


Behind the Name...
Hickman, Williams & Co.
• Behind the name Hickman, Williams & Co. is a 61-year history of service to the foundry industry. During these decades of progressive growth the Hickman, Williams organization has constantly held to the highest standards of performance and dependability.
Now, with a big job ahead, this national organization is prepared to render even greater and more efficient service.
To learn more about the distinct advantages of dealing with Hickman, Williams, contact the office nearest you.
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PIG IRON — SILVERY — FERROPHOSPHORUS — SPIEGELEISEN — COAL — COKE — SHOT — GRIT — FLUORSPAR — SANDS — CLAYS — REFRACTORIES
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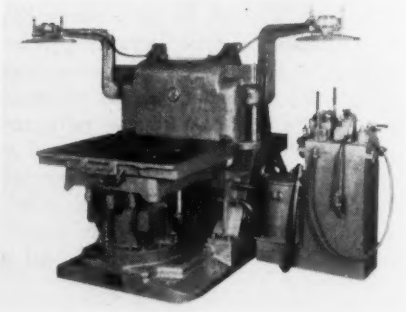
Established 1890

(*Concluded from page* 208)

type or the sensitive micro-ammeter type. It also may be used to actuate relays for automatic control mechanisms. Electrical instrumentation may be located near or far away from the load sensitive element. Accuracy of measurement is said to be within plus or minus ¼-per cent of rated capacity, and the cells are temperature and modulus compensated.

For More Details Circle No. 23—Page 199

Molding Machine: SPO Inc., 6449 Grand Division Ave.., Cleveland 25—Jolt rock-over pattern-draw machine has a 1500-lb jolt capacity on 800 psi line pressure and a 10 to 20-in. pattern draw stroke. Rock-over table is locked automatically in both jolt and pattern-draw position by the rock-over air cylinders which prevent it from slapping when being

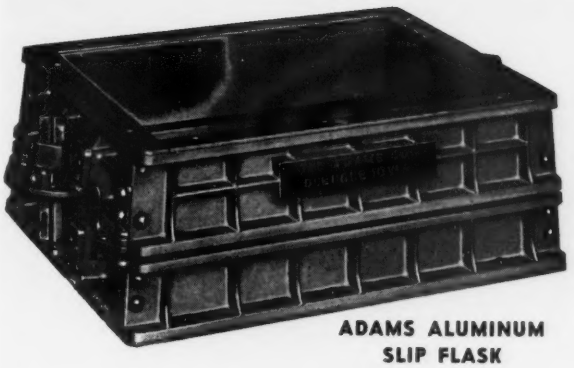


jolted or springing during the draw operation. Two quick-acting, air operated, diaphragm type flask clamps hold flask and bottom board securely against the table during the rock-over. Machine has centralized controls, air locked leveling bars, automatically controlled valve to govern the entire rock-over operation and an adjustable air-on-oil two-speed draw. Having open ends, the machine can handle flasks of any length and up to 32 in. wide. Maximum flask space is 24 in. and minimum, 16 in. It is equipped with an automatic air line lubricator, lubrication fittings, and two integrally mounted 1¼-in. air vibrators.

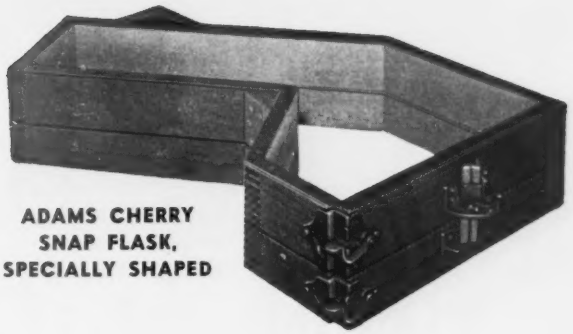
For More Details Circle No. 24—Page 199

Rust Inhibitor: Alox Corp., 3931 Buffalo Ave., Niagara Falls, N. Y.—Oil soluble rust inhibitor, which protects metals from corrosion, is said to adhere tenaciously to metal surfaces, bonding the oil to the surface, to form a dense barrier to corrosion by moisture, salt water, and corrosive gases. It is suitable for protecting meta's or equipment during fabrication or storage. Oils containing the rust inhibiting additive are said to be easy to apply and easy to remove.

For More Details Circle No. 25—Page 199



ADAMS ALUMINUM
SLIP FLASK



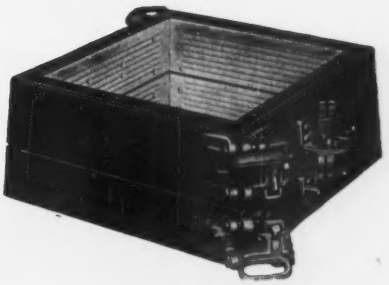
ADAMS CHERRY
SNAP FLASK,
SPECIALLY SHAPED

For "All-Out" Production use

ADAMS-BUILT

FLASK EQUIPMENT

Tell us <u>now</u> what you'll need

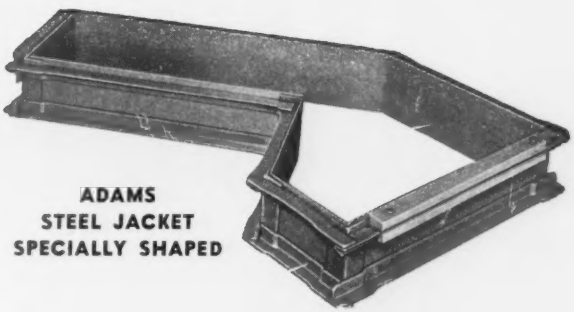


ADAMS CHERRY
EASY-OFF FLASK

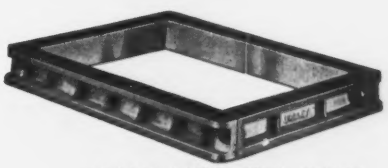
Lest the rising tide of "all-out" production swamp you with unfilled orders . . . we urgently request that you review the needs of your foundry for molding machines, flasks and allied equipment.

If you will then place your order at once, we shall make every effort to deliver your equipment on the date you must have it.

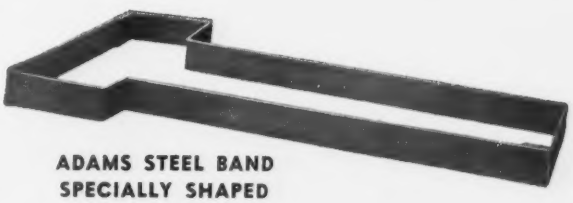
As you know, the battle of the production line is not won with "rejects". *Adams-Built* molding machines and flask equipment will help you to maintain peak production of high-quality castings, reduce rejects and lower production costs. May we hear from you now?



ADAMS
STEEL JACKET
SPECIALLY SHAPED



ADAMS ALUMINUM UPSET



ADAMS STEEL BAND
SPECIALLY SHAPED

THE ADAMS COMPANY
800 Foster St. Dubuque, Iowa

The ADAMS Company

ESTABLISHED 1883

DUBUQUE, IOWA, U.S.A.

MOLDING MACHINES and FLASK EQUIPMENT

Check on its
Uniformity –
Economy –
Toughness –
20th Century
the persuasive abrasive
One of the world's largest producers of quality shot and grit—*Normalized—Cut-wire—Hard Iron
*Licensed under U.S. Patent No. 2184926
THE CLEVELAND Metal Abrasive CO.
880 East 67th Street Cleveland 8, Ohio
Howell Works: Howell, Michigan

Foundry STATISTICS

Malleable Iron

(Shipments of castings—net tons[1])

	Shipments—Total	Shipments—For Sale	Unfilled Orders[2]
1949	713,330	371,214	.....
1950			
Jan.	62,874	32,918	62,307
Feb.	60,386	31,249	67,049
Mar.	66,259	38,639	69,866
Apr.	69,822	36,279	76,250
May	76,161	42,432	77,074
June	82,345	46,613	86,783
July	67,514	37,198	105,300
Aug.	86,021	50,019	132,374
Sept.	82,479	46,927	152,583
Oct.	89,968	50,157	160,278
Nov.	85,163	48,670	180,099
Dec.	91,510	51,091	194,950
Total	920,502	512,192	.....
1951			
Jan.	92,508	54,817	234,060

Copper-base Alloy

(Shipments of castings—1000 pounds[1])

	Shipments—Total	Shipments—Sand	Shipments—Perm. Mold	Unfilled Orders[3]
1949	724,053	654,444	37,311	.....
1950				
Mar.	80,442	71,876	4,693	27,631
3 mo.	212,295	190,751	11,759	.....
Apr.	72,318	64,773	3,848	28,769
May	79,108	71,605	3,751	30,880
June	83,023	74,990	3,896	32,808
July	69,033	62,414	3,789	39,906
Aug.	94,013	85,948	4,258	52,513
Sept.	95,641	87,111	4,630	58,673
Oct.	105,746	96,911	5,064	66,560
Nov.	103,694	93,607	5,776	67,931
Dec.	100,548	90,513	5,985	69,569
Total	1,016,180	918,883	52,756	.....
1951				
Jan.	102,643	92,171	6,363	77,580
Feb.	96,946	87,667	5,427	75,967
Mar.	110,782	100,116	6,405	80,226
3 mo.	310,371	279,954	18,195	.....

Aluminum

(Shipments of castings—1000 pounds[1])

	Shipments—Total	Shipments—Sand	Shipments—Perm. Mold	Shipments—Die	Unfilled Orders[3]
1949	304,409	106,825	102,908	87,812	.....
1950					
Mar.	35,845	13,035	11,094	10,870	47,350
3 mo.	93,466	32,853	29,852	28,705	.....
Apr.	33,356	11,091	10,656	10,795	49,952
May	36,031	11,526	11,928	11,799	52,580
June	37,600	12,677	11,825	12,173	53,309
July	30,152	9,613	9,808	9,943	63,892
Aug.	39,852	14,117	12,682	12,207	82,564
Sept.	42,061	14,369	13,085	13,594	89,723
Oct.	47,278	15,994	14,893	15,408	102,938
Nov.	46,816	16,099	14,040	15,715	67,931
Dec.	45,999	15,675	15,052	14,322	104,380
Total	452,610	154,013	143,821	144,661	.....
1951					
Jan.	42,538	14,401	14,554	12,641	93,264
Feb.	40,785	14,106	13,082	12,852	94,581
Mar.	42,170	15,866	12,771	12,677	100,453
3 mo.	125,493	44,373	40,407	38,170	.....

Magnesium

(Shipments of castings—1000 pounds[1])

	Shipments—Total	Shipments—For Sale	Unfilled Orders[3]
1949	9,364	8,781	....
1950			
Mar.	903	849	2,322
3 mo.	2,452	2,287	....
Apr.	799	751	2,305
May	810	762	2,282
June	758	698	2,482
July	727	677	3,356
Aug.	1,147	1,078	4,855
Sept.	1,231	1,154	4,942
Oct.	1,354	1,297	5,573
Nov.	1,508	1,434	6,928
Dec.	1,528	1,444	6,958
Total	12,314	11,582	....
1951			
Jan.	1,840	1,739	8,616
Feb.	1,907	1,801	10,878
Mar.	2,156	2,058	12,196
3 mo.	5,903	5,598	....

Foundry Production Workers

Estimated Number

	Mar. 1951	Feb. 1951	Mar. 1950
Gray Iron	163,000	162,400	127,000
Malleable	27,600	27,100	21,400
Steel	59,400	57,100	36,800
Nonferrous	93,100	93,700	69,800

Average Weekly Earnings

Gray Iron	....	$70.15	$59.85
Malleable Iron	....	71.01	61.50
Steel	....	73.66	60.72
Nonferrous	....	71.90	63.47

Average Weekly Hours

Gray Iron	...	42.8	40.3
Malleable Iron	...	42.6	39.5
Steel	...	42.7	39.1
Nonferrous	...	41.8	40.4

Labor Turnover Rate (Feb.)

(Per 100 employees)

	Total Accession	Total Separation	Quit	Layoff
Gray Iron	5.4	4.9	2.8	0.8
Malleable Iron	6.6	5.4	3.3	0.5
Steel	7.5	4.9	3.2	0.5
Nonferrous	4.6	4.6	2.1	1.2

Source: Bureau of Labor Statistics.

Gray Iron Castings—Shipments

(Net tons[1])

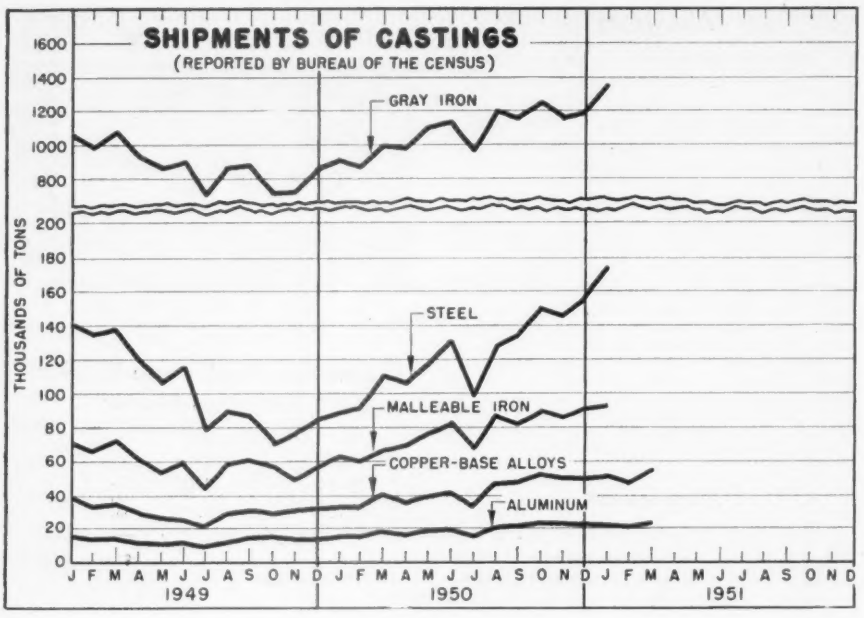
	All Castings—Total	All Castings—For Sale	Miscellaneous Castings—Total	Miscellaneous Castings—For Sale	Heavy Steel Ingot Molds—Total	Heavy Steel Ingot Molds—For Sale	Chilled Railroad Car Wheels—Total	Chilled Railroad Car Wheels—For Sale	Pressure Pipe & Fittings Total[2]	Soil Pipe & Fittings Total[2]	Unfilled Orders[2] Total
1949	10,549,284	5,521,441	6,624,420	2,675,411	1,776,242	759,860	555,569	493,117	1,029,743	563,310	.....
1950											
Jan.	913,321	449,577	573,743	214,752	188,152	88,244	34,254	29,409	64,095	53,077	914,185
Feb.	864,189	416,594	551,060	201,468	169,605	75,832	33,417	29,187	63,363	46,744	873,455
Mar.	995,782	500,195	635,403	244,122	170,082	71,317	44,898	39,357	89,264	56,135	921,575
Apr.	981,126	483,862	621,368	233,397	182,420	77,923	42,768	37,972	82,774	51,796	922,255
May	1,095,111	572,887	684,632	277,447	195,021	86,016	46,219	40,185	104,529	64,710	977,833
June	1,136,129	613,084	713,811	300,863	197,474	91,377	45,672	41,672	106,980	72,192	1,039,618
July	961,450	507,867	595,918	241,632	177,154	82,363	35,066	30,560	94,438	58,874	1,286,579
Aug.	1,201,569	677,134	747,046	335,868	199,770	92,340	52,508	46,681	131,127	71,118	1,670,380
Sept.	1,159,240	648,966	722,667	325,019	203,191	94,968	44,707	40,304	121,556	67,119	1,794,118
Oct.	1,254,901	700,512	792,764	364,607	220,821	100,082	46,516	41,023	119,105	75,695	1,839,866
Nov.	1,160,770	656,745	733,570	343,073	194,271	85,057	44,382	40,068	115,465	73,082	1,930,176
Dec.	1,181,974	652,929	745,766	333,033	210,700	98,071	43,667	39,984	111,066	70,775	2,012,480
Total	12,905,562	6,880,352	8,117,748	3,415,281	2,308,661	1,043,590	514,074	456,402	1,203,762	761,317	.....
1951											
Jan.	1,364,311	762,407	875,437	405,863	228,824	103,475	56,046	49,065	131,779	72,225	2,297,705

Steel Castings—Shipments

(Net tons[1])

	All Castings—Total	All Castings—For Sale	All Castings—Railway Specialties[3]	Carbon Steel—Total	Carbon Steel—For Sale	Carbon Steel—Railway Specialties[3]	Alloy Steel—Total	Alloy Steel—For Sale	Alloy Steel—Railway Specialties[3]	Unfilled Orders[3] Total
1949	1,250,460	865,297	232,976	944,232	659,454	223,310	299,270	205,843	9,666	.....
1950										
Jan.	88,821	57,996	9,298	64,616	41,559	8,607	24,205	16,437	691	142,484
Feb.	91,827	62,045	10,920	66,843	44,473	9,589	24,984	17,572	1,331	165,186
Mar.	111,772	77,588	15,281	82,458	56,492	14,012	29,314	21,096	1,269	185,611
Apr.	106,964	75,133	17,406	79,912	56,008	16,124	27,052	19,125	1,282	201,643
May	117,944	83,845	20,552	88,202	63,658	18,811	29,742	20,187	1,741	198,078
June	131,097	94,637	27,065	96,365	72,427	24,653	34,732	22,210	2,412	206,799
July	98,269	68,874	15,734	70,122	51,204	14,577	28,147	17,670	1,157	255,418
Aug.	128,369	94,413	24,922	92,197	70,721	22,952	36,172	23,692	1,970	329,944
Sept.	134,574	96,738	25,295	98,523	74,052	23,992	36,051	22,686	1,303	427,969
Oct.	149,558	109,660	30,048	112,704	85,157	28,493	36,854	24,503	1,555	521,846
Nov.	145,929	108,263	30,775	110,476	84,316	29,245	35,453	23,947	1,530	537,666
Dec.	155,258	113,692	34,061	118,744	88,552	32,160	36,514	25,140	1,901	554,187
Total	1,459,382	1,042,884	261,357	1,081,162	788,619	243,215	379,220	254,265	18,142	.....
1951										
Jan.	174,056	124,002	37,790	135,086	98,197	37,278	38,970	25,805	4,308	675,385

[1] Source: Bureau of the Census. [2] All cast iron pipe is shipped for sale. [3] For sale only.



Index of Foundry Equipment Orders

Foundry Trades Only

(Net Orders Closed, New Equipment)

	1950	1951
Jan.	159.3	668.0
Feb.	113.1	638.6
Mar.	225.2	599.0
Apr.	160.6	490.1
May	294.9	....
June	622.7	....
July	401.8	....
Aug.	693.6	....
Sept.	483.8	....
Oct.	526.8	....
Nov.	885.5	....
Dec.	526.2	....

Note: Figures are percentages of the base period 1937-1939 taken as 100 per cent (monthly average). Source: Foundry Equipment Manufacturers Association.

Coke Production and Consumption

(Net tons*)

	Production	Consumption Total	Consumption By Foundries
1949	63,637,429	63,462,233	2,778,868
1950			
Mar.	5,280,660	5,371,012	241,844
3 mo.	14,756,800	15,993,040	696,848
Apr.	6,156,294	6,005,632	277,673
May	6,397,032	6,385,493	294,334
June	6,238,067	6,255,094	276,555
July	6,368,489	6,265,821	267,142
Aug.	6,417,404	6,420,483	278,306
Sept.	6,263,214	6,243,584	274,657
Oct.	6,649,935	6,543,428	332,444
Nov.	6,243,970	6,131,733	317,120
Dec.	6,606,464	6,590,823	322,458
Total	72,097,669	72,735,131	3,337,517
1951			
Jan.	6,791,828	6,766,767	330,698
Feb.	6,001,616	6,037,085	291,255
Mar.	6,680,321	6,635,064	299,190
3 mo.	19,477,149	19,438,916	921,143

Ingot Brass and Bronze

(Shipments in net tons)

	1950	1951
Jan.	18,874	28,416
Feb.	18,487	27,168
Mar.	22,494	31,997
Apr.	22,118	30,472
May	23,643	.....
June	25,093	.....
July	21,609	.....
Aug.	29,689	.....
Sept.	28,811	.....
Total for year	303,563	.....

Zinc-Base Alloy

(Shipments of castings—1000 pounds[1])

	Shipments—Total	Shipments—For Sale	Unfilled Orders[2]
1949	377,779	248,679	.....
1950			
Oct.	51,031	33,287	97,102
Nov.	48,852	32,844	102,524
Dec.	47,818	31,161	102,636
Total	536,398	341,833	.....
1951			
Jan.	41,166	27,646	90,596
Feb.	38,964	25,307	93,605
Mar.	44,173	27,914	100,652
3 mo.	124,303	80,867	.....

Iron and Steel Scrap Consumption

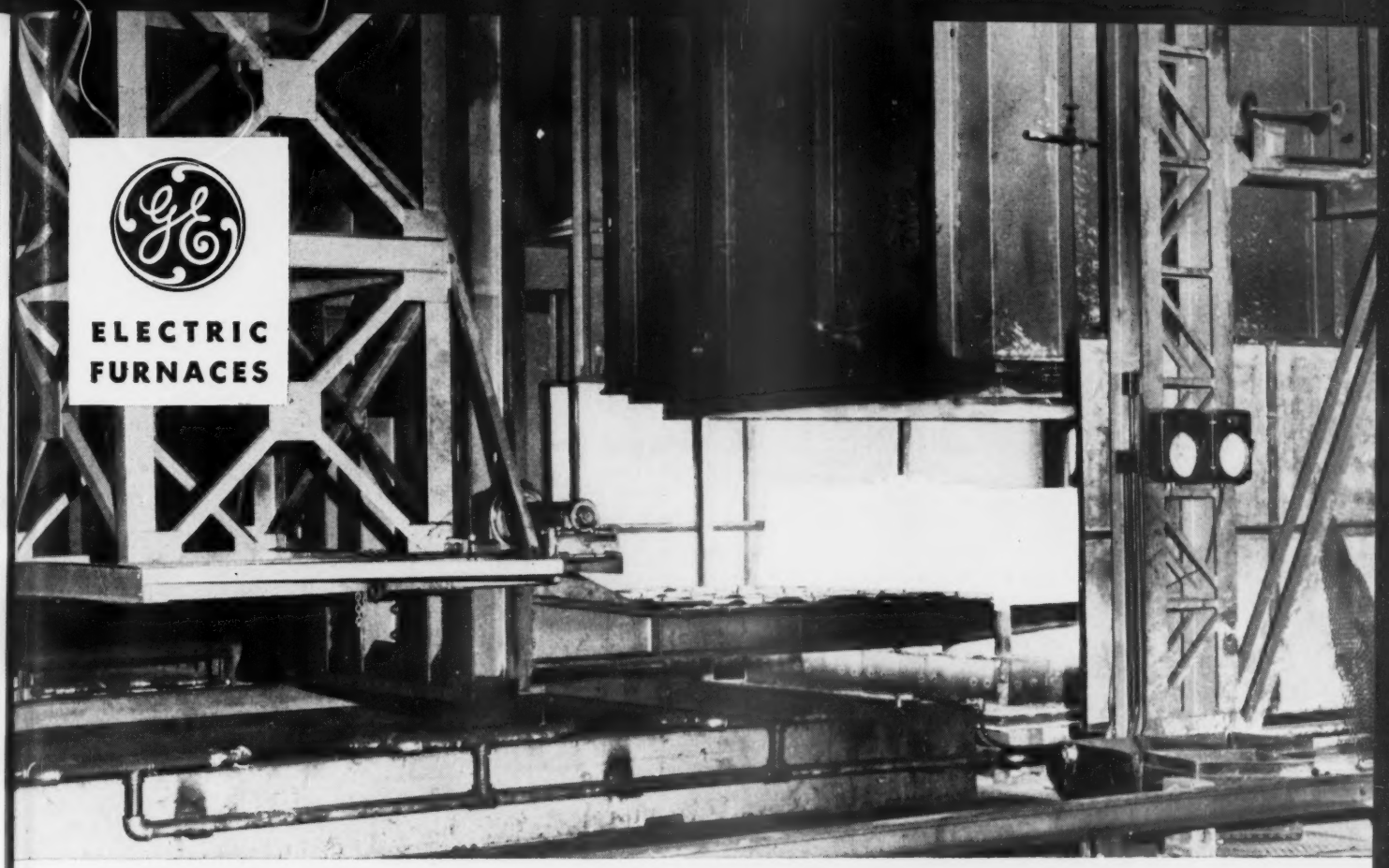
(Thousands of gross tons*)

	All Scrap—Total	All Scrap—Purchased	By Type of Furnace: Cupola—Total	Cupola—Purchased	Air—Total	Air—Purchased	Electric—Total	Electric—Purchased
1949	49,281	22,922	7,968	4,175	801	276	4,239	2,608
1950								
Jan.	4,906	2,267	699	337	71	25	433	259
Feb.	4,539	2,149	670	315	71	27	417	253
Mar.	5,101	2,430	778	372	87	31	497	296
Apr.	5,119	2,451	766	365	79	29	493	300
May	5,333	2,552	837	416	85	32	539	324
June	5,122	2,483	864	427	92	33	533	317
July	4,708	2,244	669	318	79	28	490	295
Aug.	5,202	2,454	862	426	108	39	568	327
Sept.	5,170	2,468	819	404	109	40	579	348
Oct.	5,643	2,707	866	437	108	40	643	384
Nov.	5,293	2,598	841	431	107	39	593	364
Dec.	5,361	2,600	803	418	122	44	600	361
12 Mo.	61,497	29,403	9,474	4,666	1,118	407	6,385	3,828
1951								
Jan.	5,975	3,010	1,009	534	110	41	684	436

Pig Iron Production and Consumption

	Production** (Standard grades—1000 net tons): Total	Foundry	Malleable	Basic	Low Phos. Intermediate Low Phos. & Bessemer	Consumption* (By type of furnace, 1000 gross tons): Total	Cupola	Air	Electric
1949	53,408.7	2,821.9	2,294.5	41,312.5	6,979.8	47,928	4,510	235	96
1950									
Apr.	5,502.8	259.2	229.1	4,298.3	716.2	4,954	449	23	11
4 mo.	19,378.7	882.0	844.6	15,125.7	2,526.4	17,830	1,714	86	109
May	5,773.6	257.7	223.5	4,572.3	720.1	5,203	474	24	13
June	5,549.3	209.5	257.7	4,393.8	688.3	5,033	494	25	13
July	5,804.2	269.3	282.2	4,561.2	691.5	5,018	403	23	14
Aug.	5,706.2	257.0	284.0	4,407.3	757.9	5,136	516	30	18
Sept.	5,614.6	244.0	257.2	4,380.9	732.5	5,092	500	26	17
Oct.	5,836.8	284.1	260.6	4,541.2	741.0	5,219	466	31	13
Nov.	5,316.5	277.1	279.1	4,093.7	666.6	4,817	462	30	14
Dec.	5,609.2	264.9	260.2	4,374.4	709.8	5,068	456	34	15
12 Mo.	64,589.1	2,870.4	3,034.2	50,450.5	8,234.0	58,416	5,475	319	326
1951									
Jan.	5,801.7	300.0	233.3	4,529.8	738.6	5,367	542	32	11
Feb.	5,084.8	238.7	226.0	4,007.2	612.9	....	....	....	....
Mar.	5,919.3	267.9	276.5	4,647.5	727.5	....	....	....	....
Apr.	5,812.2	259.1	261.0	4,575.8	716.1	....	....	....	....
4 Mo.	22,617.0	1,065.7	996.8	17,759.8	2,795.1	....	....	....	....

* Source: U. S. Dept. of Interior, Bureau of Mines. ** Source: American Iron & Steel Institute. [1] Source: Bureau of the Census. [2] For sale only.



ANNEALED 3 TIMES AS FAST

National Malleable and Steel Casting Co., Cleveland, Ohio, cut the time cycle from *6 days to 48 hours* for annealing automotive castings with G-E electric furnaces.

IMPROVES QUALITY

- because uniform heat produces more uniformly annealed castings.
- because decarburizing is eliminated. Tight furnace construction retains the cost-free protective atmosphere generated by the castings during annealing.

CUTS COSTS

- because no auxiliary protective atmosphere equipment is needed.
- because no containers for castings are used. Castings are loaded directly on grids and placed in the furnace.
- because less power is required for heating, since packing sand and heavy containers are eliminated.

The compact, well-designed furnaces provide safer working conditions and result in cleaner, cooler operations. National is so satisfied with savings in *over-all costs* and faster production that they now have 20 more G-E furnaces on order.

WHY DON'T YOU consider these advantages and contact the G-E Apparatus Sales Office nearest you to obtain the recommendations of an Industrial Heating Specialist. Or write to: Sect. 720-42, General Electric Co., Schenectady 5, N. Y. General Electric can supply you with a complete line of electric furnaces, gas atmosphere equipment, induction and dielectric heaters and small heaters and devices.

You can put your confidence in—

GENERAL ELECTRIC

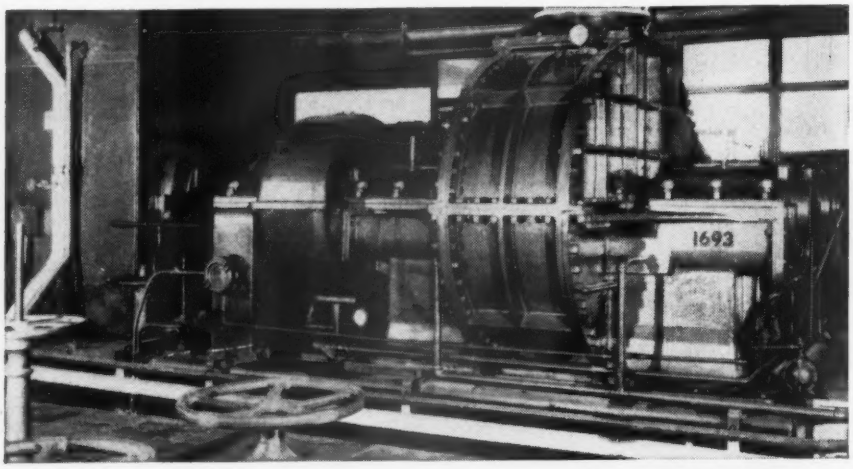
720-42

NEW R·C EXHAUSTER
pays its own way

By replacing a 30-year-old battery of three steam-driven gas exhausters with a new, high-capacity, electrically-driven R-C unit, important advantages were gained, in a large industrial plant:

1. **The one new unit carries the base load.**
2. **Steam needed for 5 other steam-driven exhausters, carrying partial load, is substantially reduced because of slower speeds.**
3. **Heat balance in the plant is maintained.**
4. **Savings in total power cost will pay for the new installation in about one year.**

These very satisfactory results were obtained by careful evaluation of all the factors before deciding upon the type of equipment . . . and then by specifying an R-C Rotary Positive Gas Exhauster that will do the work at low operating cost.



Type RCGH Rotary Positive Gas Exhauster, driven by 450 hp synchronous motor. Capacity, 20,600 cfm.

Even though your equipment to handle gas or air may still have years of life, it may be sound economy to replace it with modern, efficient, R-C units of the right type, size and drives to best meet your needs. Our engineers will help you analyze your problem and make unbiased recommendations of either Rotary Positive or Centrifugal equipment, depending upon your specific conditions. This *dual choice* is an exclusive R-C advantage.

With capacities from 5 cfm to 100,000 cfm, R-C units can be closely matched to work requirements, for dependable, economical performance. At Roots-Connersville, almost a century of blower building experience is at your service, without obligation.

Type OI Centrifugal Blower in foundry of large manufacturing company. Capacity 6,300 cfm.

ROOTS-CONNERSVILLE BLOWER CORP.
151 Madison Avenue, Connersville, Indiana

ROOTS-CONNERSVILLE
BLOWER BUILDERS R-C SINCE 1854
ONE OF THE DRESSER INDUSTRIES

OBITUARY

CARL F. LAUENSTEIN, 50, who died in the Pennsylvania railroad wreck at Bryn Mawr, Pa., May 19, had been associated with the Link-Belt Co. for 28 years and had been chief metallurgist for the company's two Indianapolis plants since 1936. Since last Jan. 1 he had been director of research. Mr. Lauenstein, graduated from Purdue University in 1922, was active in the Malleable Founders' Society and was a member of several committees of the Malleable Division, American Foundrymen's Society.

* * *

William T. Hunter, 71, until his retirement in 1949, president, A. Schrader's Son, and former vice president, Scovill Mfg. Co., Brooklyn, N. Y., died Apr. 19. His home was in Darien, Conn. Mr. Hunter, at the time of his death was a director of Scovill Mfg. Co., manufacturer of pneumatic valves.

* * *

Albert Kusch, 66, formerly foundry instructor, Chain Belt Co., Milwaukee, died there May 14. He came from Germany at the age of 3 years and became a coremaker apprentice for Northwestern Malleable Foundry at 13 years of age. He was employed by Chain Belt Co. for 38 years.

* * *

Albert E. Hansen, 82, founder of Elkhart Brass Mfg. Co., Elkhart, Ind., died there May 11. Mr. Hansen came to the United States from Norway as a youth and worked for Crane Plumbing Supply Co., Chicago, for 12 years. He organized his own company in 1902.

* * *

Louis X. Ely, 74, retired president of the former Monessen Foundry & Machine Co., Pittsburgh, died there May 23. Following sale of his company to Rockwell Mfg. Co., Pittsburgh, in 1945, he became general manager and retired in 1948.

* * *

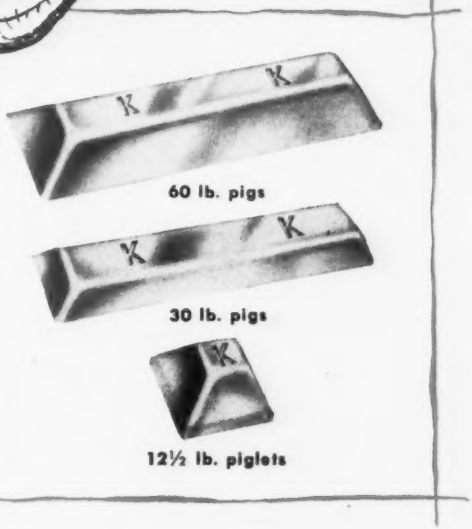
Martin Kettler, former owner of the Kettler Brass & Mfg. Co., Houston, Tex., and Pittsburgh, died May 24 in San Francisco. Mr. Kettler, an inventor, and native of Germany, retired from the brass foundry industry about 20 years ago.

* * *

Albert J. Hall, 67, metallurgist, died May 9 in Detroit. A graduate of University of Michigan, Mr. Hall was formerly research metallurgist for General Motors Corp. and Hewitt Metals Corp., Detroit.

You can't beat this Keokuk team! For either blocking the open hearth heat or for charging the cupola . . . Keokuk is *always* a champion. "Pig for pig . . . car for car," the quality and uniformity of Keokuk Electro-Silvery *never* varies!

KEOKUK
ELECTRO-SILVERY



KEOKUK ELECTRO-METALS COMPANY

Keokuk, Iowa • Wenatchee Division: Wenatchee, Washington

SALES AGENTS: **Miller and Company**
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Cut blast cleaning costs with
EXTRA TOUGH
"Certified" Abrasives
Switch to Certified Abrasives and keep cleaning costs down! Certified's Samson Shot and Angular Grit are made extra tough by a special automatically controlled hardening process. They wear longer, can be used over and over again . . . and assure fast, efficient, high-quality blast cleaning. Try Certified in your cleaning room and you'll see why it's first choice in hundreds of foundries!
All sizes graded to S. A. E. specifications
Experienced foundrymen say:
Always specify "Certified"
Accepted and used for over 55 years
PITTSBURGH CRUSHED STEEL CO.
Pittsburgh, Pa.
STEEL SHOT AND GRIT CO.
Boston, Mass.
MEMBER FEMA

Centrifugal Casting

(*Continued from page* 79)

thermal gradient such as is associated with the use of a metal mold, in which nearly all of the heat in the cast metal quickly flows radially outward into the mold, the problem of feeding into the progressively solidifying casting is greatly eased.

One of the most stimulating outgrowths of the casting method described is the development of a process for making hollow cylinders involving the use of more than one metal. The process is essentially as follows: Into a rotating mold, coated as previously described, is first poured a measured quantity of one metal. When this has been allowed to cool to a temperature at its inside somewhat below its freezing point, a measured amount of a second and different metal is introduced without interruption of mold rotation and the mold is maintained in rotation until the interior of the inner or core metal has completely solidified. An integral structure composed of two concentric well-bonded cylinders, each having its characteristic chemical and physical properties, is produced.

With the use of metal molds, a high order of uniformity of the isothermal lines, both longitudinally and annularly, is assured as the inner surface of the outer metal solidifies. This condition minimizes the tendency of the core metal to dig into the outer shell layer by solution and remelting in some places and to refuse to bond in other places. The temperatures are sufficiently high to assure fusion and the centrifugal action serves two purposes. Impurities on the inner surface of the first metal cast, being agglomerated and of lower density, are flushed through the liquid second metal and collected on its interior.

In addition, the centrifugal force acts as a positive positioning medium so that the necessary interactions for welding can occur. Despite certain limitations the process offers a challenging variety of useful products when one considers that into one integral structure can be combined performance properties typical of two or more different metals, each independently controlled and each having unique properties which no single alloy can combine.

Products — The consumer, particularly the design engineer, is more interested in the product than the methods of making it. He wants to know what the product can do and

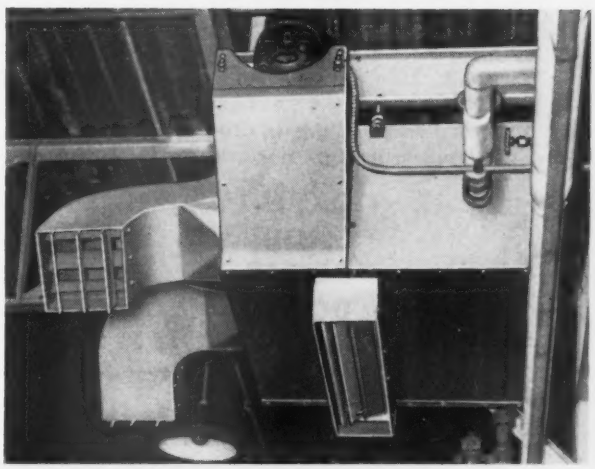
(*Continued on page* 220)

Settle Next Winter's HEATING PROBLEMS *Now!*

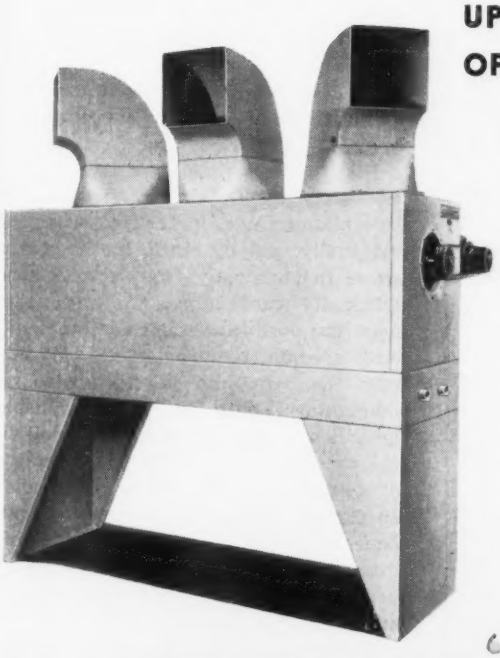
INSTALL "Buffalo" UNIT HEATERS

QUICK HEAT FOR SMALL AREAS!

Plan now to wipe out any chilly areas that cramped production last winter. "Buffalo" Breezo-Fin Heaters are very easily installed in suspended position. They operate efficiently on as little as 2 lbs. steam—are available in 20 sizes—have quality Aerofin heater element for maximum radiation and "Buffalo" Breezo Fan for positive heat throw. Now is the time to write for Bulletin 3137-D for the facts!



UP AND OUT OF THE WAY!



Another space-saver is the Suspended "Buffalo" Lowboy Heater, here supplying fresh, filtered, heated air to an entire room. This window installation is ideal in supplying makeup air for plants using large-capacity exhaust systems. Unit has high-efficiency non-corrosive Aerofin heater element and "Buffalo" mixed-flow fans on hollow shaft.

TO HEAT LARGE FLOOR AREAS!

The compact Highboy Heater, with readily adjustable outlets for louvers or duct connection, is simple to install as are all "Buffalo" Unit Heaters. Unit shown is equipped with by-pass damper and the same efficient coils and fans as the Lowboy above. Arrangements and combinations to fit *your* layout. Plan *now* for next winter—write for Bulletin 3704!

"Buffalo" FIRST FOR FANS

BUFFALO FORGE COMPANY

221 MORTIMER ST. BUFFALO, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont. Branch offices in all Principal Cities

VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT EXHAUSTING PRESSURE BLOWING

CRESCENT CHAPLETS

If you don't see it here .... ask for it!

We manufacture a complete line of all types and sizes of Foundry Chaplets, and all kinds of wire and metal formations for your foundry use. If we don't already make what YOU need, we'll design and develop just the CHAPLET to suit your requirements. Your inquiries and specifications are invited . . . . for quick service, write for working samples. As a few of our specialties:

- **RADIATOR CHAPLETS**
- **SHOULDER CHAPLETS**
- **BOILER CHAPLETS**
- **DOUBLE HEAD CHAPLETS**
- **MOTOR CHAPLETS**
  (Regular or Extended stems)
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  (Plain or Perforated)
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  (Plain, Nicked or Barbed)
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CRESCENT FUSETITE CHAPLETS ARE MADE ACCURATE OF PROPER ANALYSIS MATERIALS FOR THE FUSING-IN PROCESS.

Being the Originators and Manufacturers of Radiator, Shoulder, Double Head and Motor Chaplets, Your Foundry benefits by our Chaplet Manufacturing experience since 1889 for the leading Stove, Radiator, Boiler and Motor Foundries.

We carry thousands of different types and sizes in stock for quick delivery, and have the facilities to make up special sizes promptly.

WRITE FOR SAMPLES AND PRICE LIST.

Crescent Brass & Pin Company

5766 TRUMBULL AVE.

DETROIT 8, MICHIGAN

(*Continued from page* 218)

where it can be used. Owing to the diversity of the products in question, they will be grouped in the following categories: Cast irons; steels, low alloy and high alloy; dual metal castings. In each category some typical applications and use properties, both chemical and physical, will be indicated.

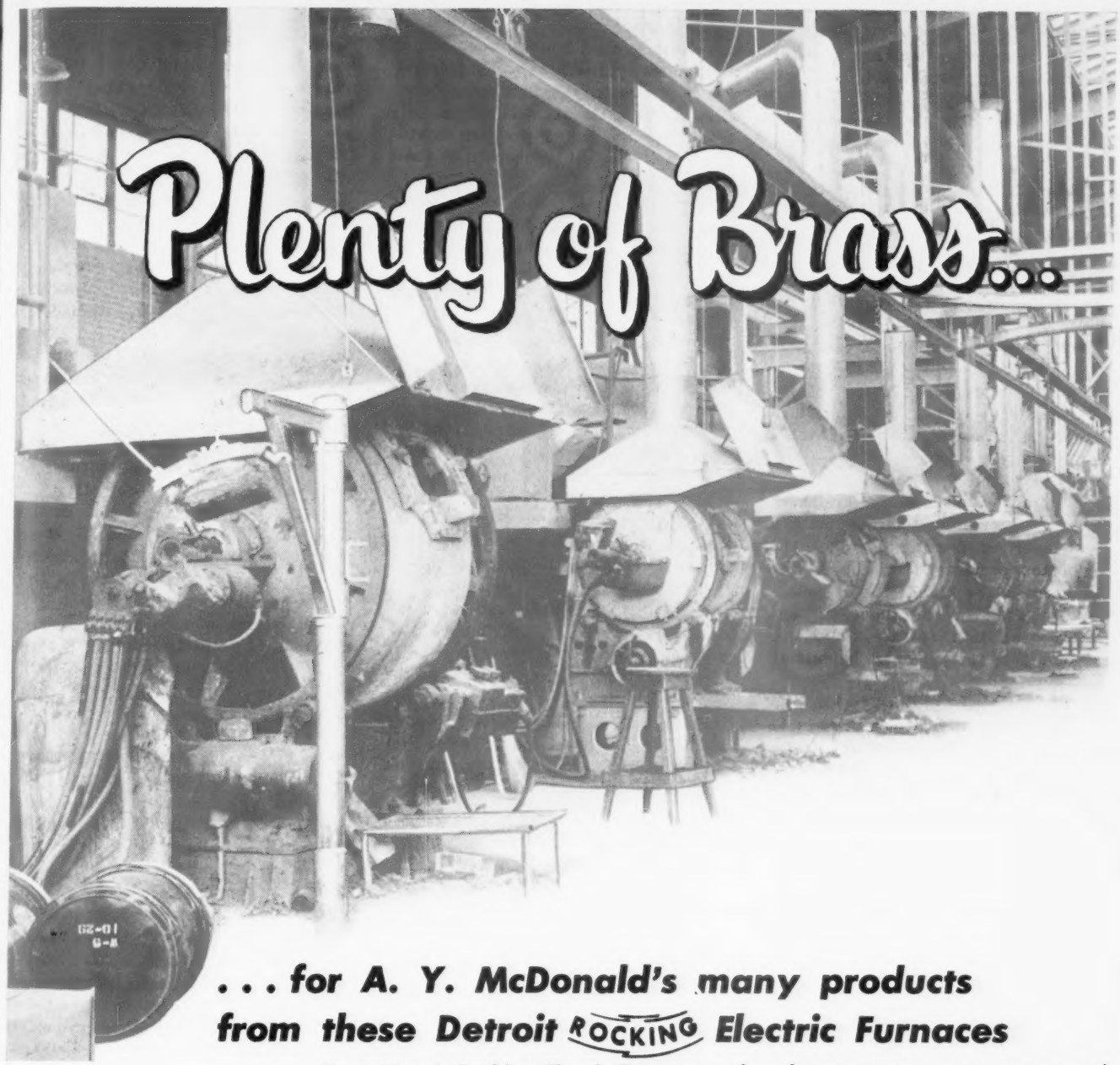
Cast Irons—Practically all of the known cast irons, such as pearlitic gray irons, acicular iron, chill iron, malleable, Ni-Hard and Ni-Resist irons, have been successfully cast centrifugally by the new process. Sizes range from a 1½-in. ID chemical piping, having a wall thickness of 0.2-in. and a length up to 10 ft, to castings having a 30-in. diameter, a wall thickness up to several inches, and lengths to 12 ft. The tensile strengths obtained depend on the type of iron cast, typical values being 40,000-45,000 psi for the pearlitic irons to over 65,000 psi for the stronger irons such as the acicular type and others.

Heat treatment of these irons is not normally required, but some of them are subjected to special thermal treatment, depending on the kind of iron and its specific final applications. The end uses of these products are quite diverse, including, by way of example, such materials as chemical piping, piston ring stock, automotive and diesel engine sleeves, rollers for conveyors in the steel industry, process rolls, bearing back shell stock, abrasion resistant piping, etc. Because of their special requirement, three of these applications will be briefly discussed.

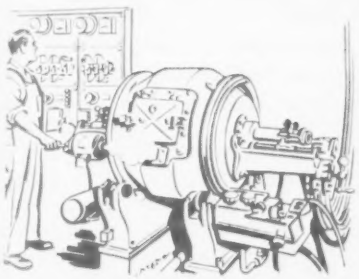
Piston Ring Stock—A new industry is developing in which automotive piston rings, instead of being individually cast by static methods, are sliced mechanically from a long centrifugally cast tube. To meet this need the cast tube must combine several specific requirements. To satisfy the economic needs, no rough machining operation is permissible and, hence, the tubes are shipped in their as-cast state with a guarantee of clean-up at the outer and inner surfaces. With a maximum allowance of 0.050-in. depth of cut, millions of rings have been satisfactorily processed with negligible loss due to surface imperfections.

Again, to save costs, the material must not require heat treating. This means that the tube, cast in a metal mold, must be free of chill. At the same time, to assure good wear properties, it must not contain free ferrite. These conflicting requirements have been resolved by a judicious

(*Continued on page* 222)



. . . for A. Y. McDonald's many products from these Detroit ROCKING Electric Furnaces



Faster melts— better melts—
ROCKING ACTION DOES IT!

Seven Detroit Rocking Electric Furnaces in the foundry of A. Y. McDonald Company, Dubuque, melt the brass used in the products of this well-known manufacturer.

In this plant, as in hundreds of others throughout the country, Detroit Electric Furnaces deliver high-quality, uniform melts with great speed and efficiency day after day.

ROCKING ACTION

This exclusive feature makes for faster melts, more economical use of heat, minimizes the possibility of segregation. Close control of the rocking cycle, possible with these furnaces, means more exact control of melt characteristics, duplication of desired results through melt after melt.

RESULTING ECONOMIES

Better melts mean better castings, fewer rejects. More complete use of power means lower power costs. Better design results in less down time, lower maintenance costs.

Detroit Electric Furnaces are available in capacities from 10 to 4000 lbs. for ferrous or non-ferrous melting. Send your data. Let us show you the benefits you can have with Detroit Electric Furnaces!

DETROIT ELECTRIC FURNACE DIVISION

KUHLMAN ELECTRIC COMPANY • BAY CITY, MICHIGAN

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(*Continued from page 220*)

balance between the ferrite and pearlite forming elements in the iron to assure a fully pearlitic matrix. This type of iron gives an average tensile strength of 45,000 psi at a hardness level not exceeding Rockwell B-105. In addition to yielding a piston ring stock, it serves equally satisfactorily as an automotive sleeve material.

Bearing Back Stock — Several of the largest diesel engine manufacturers have standardized on the use of heavy wall iron cylinders cast centrifugally in metal molds for bearing back material. The castings, after a stress relief, are shipped in the as-cast state in multiple lengths and then cut to length, machined on their surfaces to dimension, split longitudinally, and lastly are babbitted on their inner surface with a thin layer of bearing metal. The important property that comes into play here is the high order of soundness required of the inner surface. Porosity at this surface would be ruinous for the critical babbitting operation.

Abrasion-Resistant Piping—For conveying highly abrading materials such as fly ash and frit materials for the glass and ceramic industries, centrifugal castings of Ni-Hard are finding increasing applications. In the glass industry, air conveying is coming into use and transport speeds of 100 miles per hour are employed. Field experience to date has shown that a centrifugal casting of Ni-Hard has out-lasted previous materials, inclusive of rubber-lined steel piping, many-fold. Unalloyed white irons, with mild reduction in abrasion resistance, but the elimination of elements in short supply, are also in use.

Steels:

Low Alloy Steels—Virtually all of the SAE grades of steel have been successfully cast into tubes, pipes or rolls. The outside diameters range from 2 in. through 24 in. lengths up to 12 ft, and wall thickness from ¼-in. for the small diameter piping to several inches for roll materials. In contrast to drawn tubing or elongated forgings, the mechanical properties transversely show essentially the same values as in the longitudinal direction. Furthermore, depending on the steel in question and the heat treatment employed, the mechanical properties compare favorably with those obtained by conventional wrought methods.

For purpose of illustration, a series of SAE 4140 steel heats gave the average mechanical property values shown in Table I. The tensile test specimens, 7/16-in. rounds, were machined from the center of the wall of ⅝-in. thick castings. The specimens were quenched in oil from 1600° F and tempered at 1290° F, 1150° F, and 950° F, respectively. The compositional range of the heats in question was as follows: C 0.39-0.41, Mn 0.79-0.90, P 0.015-0.023, S 0.033-0.036 Si 0.30-0.37, Cr 0.96-1.08, Mo 0.15-0.24.

More recently, for a certain product requiring high impact resistance, a steel of the following composition was employed: C 0.27, Mn 0.67, P 0.012, S 0.014, Si 0.27, Ni 1.27, Cr 0.73, Mo 0.29. The tensile specimens, ¼-in. in this case, were machined from the center of the wall of 13/16-in. castings, which were quenched in water from a temperature of 1625° F and drawn at the temperatures indicated, as shown in Table II.

High Alloy Steels: Most of the AISI and additional special steels have to date been cast successfully. Their size range is similar to that shown for low alloy steels.

For purpose of illustration, average mechanical property values of three high-alloy steels are shown in Table III. The composition of the heats from which these test specimens were taken is as follows:

	AISI 304	ASTM 25-12	AISI 316
C	0.065	0.054	0.042
Mn	1.28	1.10	1.15
P	0.014	0.014	0.011
S	0.012	0.012	0.015
Si	0.83	0.86	0.73
Cr	18.30	25.50	18.71
Ni	9.27	12.44	12.70
Mo	...	....	2.37

It was of interest to establish the effect of wall thickness or rate of freezing on the mechanical properties of castings made from these same steels. To accomplish this, a special metal mold was prepared, the inside diameter of which was machined in three steps to provide casting sections having wall thicknesses 1⅝ in., 1⅛ in., and ⅝-in. By this means problems of chemistry variation between specimens varying only in wall thickness were eliminated. From the middle of the wall of each section with different casting thickness, 0.505-in. test specimens were machined. Both as-cast and quenched specimens were tested. The results are shown in Table IV.

Quenching in water after a homogenizing treatment at 1900° F has largely eliminated the effect of freezing rate or section size reflected in the as-cast specimens. Studies were also conducted on the heavier wall sections to establish the constancy of mechanical properties across the wall

(*Concluded on page 224*)

TABLE I—Mechanical Properties, SAE 4140 Steel

Draw Temp. °F	Yield Str. psi	Ult. Str. psi	% Elong.	% Red. Area	Hardness Rockwell C
1290	92,600	104,900	25.9	51.2	18.8
1150	122,600	138,100	16.1	40.0	28.0
950	163,600	174,700	10.5	28.8	37.3

TABLE II—Properties of Steel with High Impact Resistance

Draw Temp. °F	Yield Str. psi	Ult. Str. psi	% Elong.	% Red. Area	Charpy Impact (−40°) F, ft lb
1100	120,900	135,300	17.3	53.4	53
1060	131,600	143,800	14.5	46.4	44.5

TABLE III—Properties of Three High-Alloy Steels

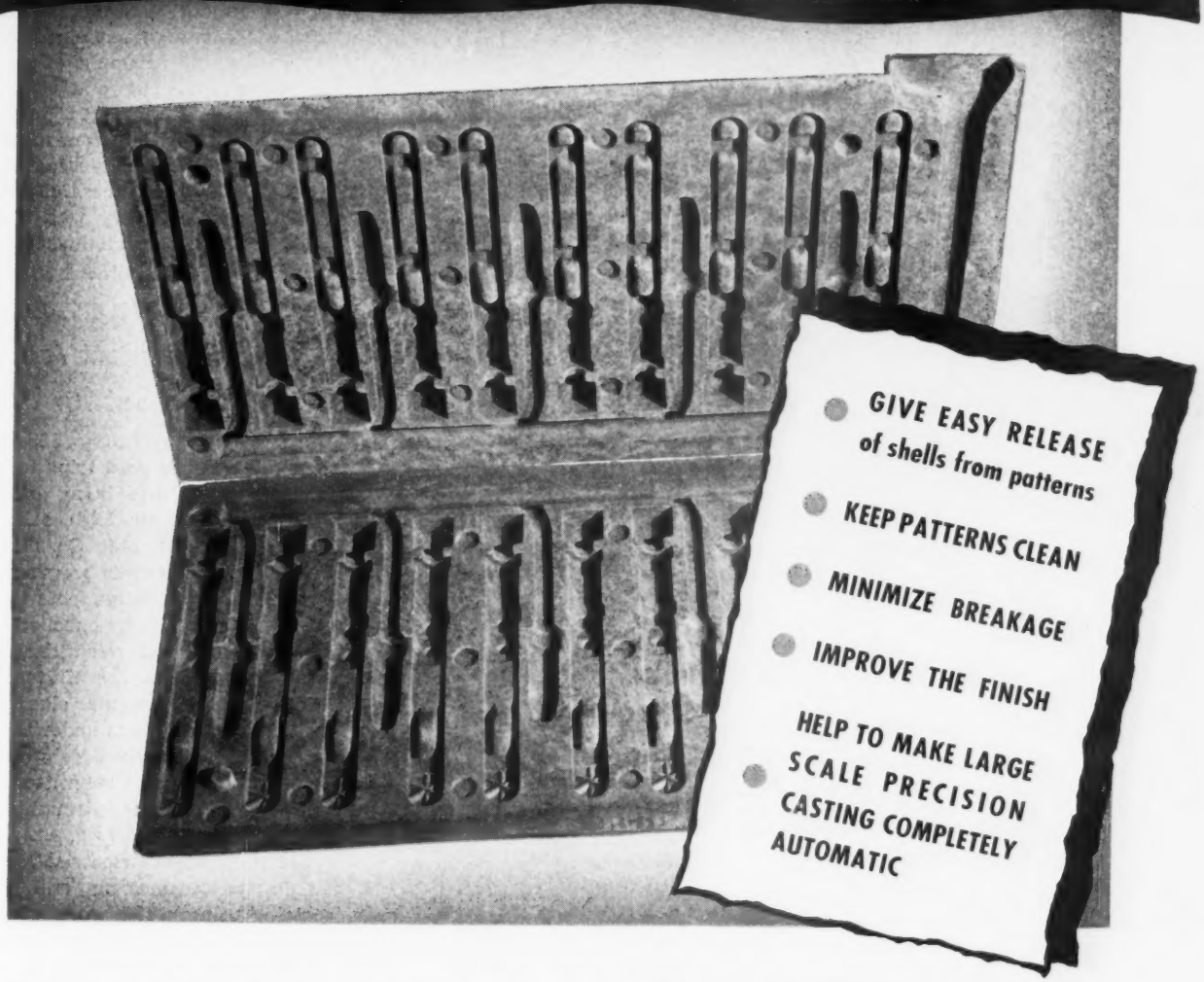
Type Steel	Treatment	Yield Str. psi	Ult. Str. psi	% Elong.	% Red. Area
AISI 304	As cast	34,040	78,450	52.1	48.6
	Quenched*	33,790	75,870	64.3	70.3
ASTM 25-12	As cast	45,750	87,450	36.8	56.5
	Quenched	48,600	84,000	35.7	71.4
AISI 316	As cast	40,770	77,820	39.3	44.8
	Quenched	39,060	74,690	51.5	68.2

* Quenched in water from 1900° F.

TABLE IV—Effect of Wall Thickness on Properties

Type Steel		Wall Thickness	Yield Str. psi	Ult. Str. psi	% Elong.	% Red. Area
AISI 304	As cast	1⅝"	34,800	81,000	51.7	36.0
	As cast	1⅛"	37,400	78,750	57.5	53.9
	As cast	⅝"	36,250	77,800	53.0	45.5
	Quenched	1⅝"	33,300	77,370	68.6	70.2
	Quenched	1⅛"	34,700	76,920	62.2	72.3
	Quenched	⅝"	33,400	73,300	62.0	68.6
ASTM 25-12	As cast	1⅝"	39,650	88,300	37.4	52.3
	As cast	1⅛"	51,000	87,100	47.0	55.5
	As cast	⅝"	49,700	89,370	34.5	52.6
	Quenched	1⅝"	49,300	86,000	39.5	69.2
	Quenched	1⅛"	49,700	84,450	34.0	73.3
	Quenched	⅝"	46,800	81,500	33.5	71.7
AISI 316	As cast	1⅝"	45,650	79,400	29.0	29.7
	As cast	1⅛"	48,300	80,000	33.5	34.4
	As cast	⅝"	42,600	80,100	39.5	46.7
	Quenched	1⅝"	38,000	72,900	51.7	69.9
	Quenched	1⅛"	39,600	75,800	54.5	69.5
	Quenched	⅝"	39,000	76,000	44.0	62.0

DOW CORNING SILICONE RELEASE AGENTS SIMPLIFY SHELL MOLDING


GIVE EASY RELEASE of shells from patterns
KEEP PATTERNS CLEAN
MINIMIZE BREAKAGE
IMPROVE THE FINISH
HELP TO MAKE LARGE SCALE PRECISION CASTING COMPLETELY AUTOMATIC

The Silicone Release Agents, originated by Dow Corning and introduced to the rubber, plastic and plywood industries in 1946, now offer large savings in the foundry field.

"Silicone jelly" was mentioned as a release agent for phenolic-sand molds in the August 1950 issue of MATERIALS AND METHODS. It was referred to again in the discussion of "Shell Molding and Use of Resin Binders" during the 55th Annual AFS meeting. In both cases, the "Silicone Jelly" was Dow Corning 7 Compound.

WRITE TODAY FOR SAMPLE OF DOW CORNING 7 EMULSION

water dilutable silicone emulsion developed especially for shell molding.

OR DOW CORNING 7 COMPOUND

applied by wiping or by spraying from a solvent solution

AND DATA SHEET NO. AH-6 or TECHNICAL ASSISTANCE

from our engineering specialists in SILICONES AS RELEASE AGENTS

DOW CORNING SILICONES

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Originally developed to expedite the casting of motor blocks and heads, MILWAUKEE "Motor" Chaplets are now used extensively in producing light sectioned castings of all kinds. They are especially recommended for light castings which are to be subjected to gas, steam, oil or water pressure.

These light, double headed (square or round) Chaplets have the famous "MILWAUKEE Thread Stem" which permits the use of a *heavier stem* . . . resulting in the double benefit of a well secured core and a pressure tight casting. Scrap losses due to "leakers" are practically eliminated.

Milwaukee Motor Chaplets are available in plain, coppered or tinned finish; also in aluminum. Write for samples and prices, or refer to Page 9 of your Milwaukee Chaplet Catalog.

MILWAUKEE CHAPLET & MFG. CO.
1025 SOUTH 40TH STREET • MILWAUKEE 4, WISCONSIN

A 5516-2/8

(*Concluded from page 222*)

structure of these same castings. The small amount of scatter found was that which would be expected of any homogeneous body of steel.

The excellent ductility of the stainless steels and the constancy of properties have made possible the reduction to tubing by either hot or cold methods of rough machined cast billets. As an example, type 301 billets, 4½-in. OD and ⅝-in. wall have been reduced to 27 gage capillary tubing with eminent success. Various difficult-to-pierce stainless steels have been successfully reduced to tubing from heavy wall billets by both hot and cold methods.

(*To be concluded next month*)

Student Project Awards Program Set for 1951

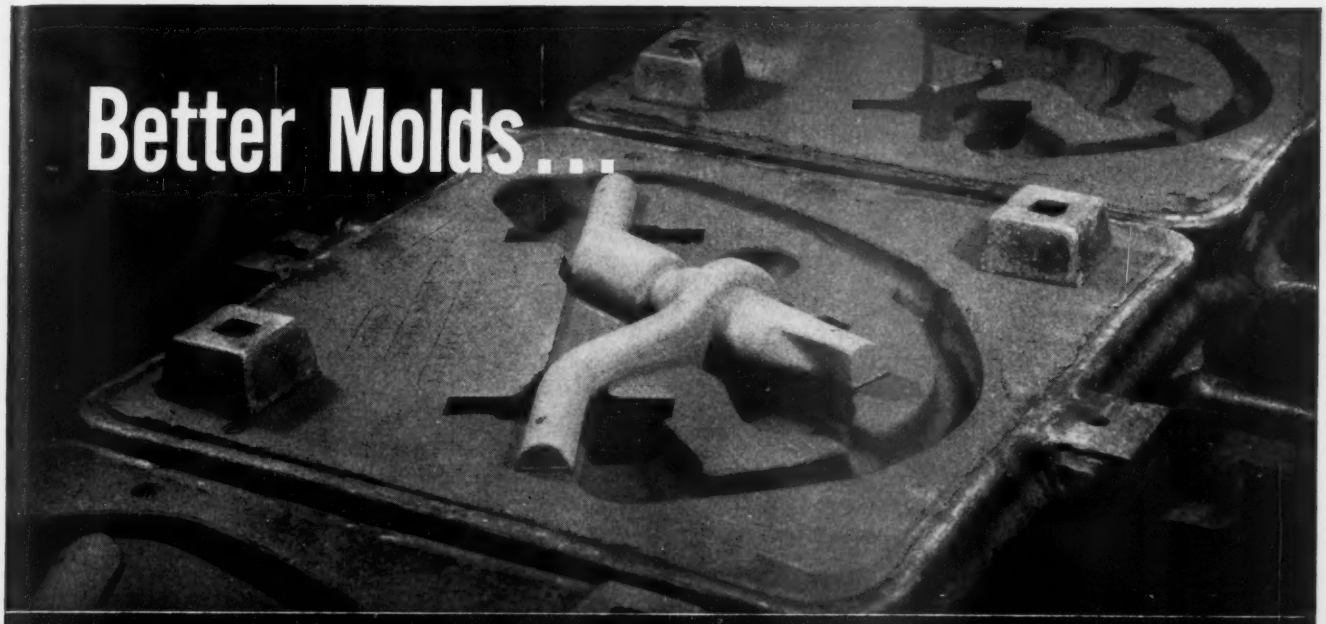
Cash prizes totaling $35,000 and nine all-expense paid trips to Detroit and Dearborn are being offered to junior and senior high school students in Ford Motor Co.'s 1951 Industrial Arts Awards program. Competition is open to students in grades seven through 12, enrolled in industrial arts and vocational classes at any school in the United States. Entries must be regular class projects made in school shops under the supervision of instructors.

Projects may be submitted in nine divisions: Plastics, wrought metal, architectural drawing, mechanical drawing, wood, electrical, machine shop, patternmaking and molding, and printing. The work of national winners will be exhibited at the Industrial Art Awards Fair, Chicago Museum of Science and Industry, Chicago, Aug. 17 to Oct. 14.

Book Review

Symposium on Ultrasonic Testing, paper, 134 pages, 6 x 9 in., published by the American Society for Testing Materials, 1916 Race St., Philadelphia 3. Price $2.

Ten papers and discussions included in this book represent a summary of the history, theoretical aspects, basic principles of practical testing, and practical applications for the ultrasonic testing of materials as presented at sessions on the subject which were sponsored by ASTM Committee E-7 on Non-Destructive Testing at the 1950 annual meeting of the society. Papers were reviewed prior to publication by their authors in the light of latest developments, and provide up-to-date pertinent and valuable information.



WITH *HERCULES*® **NVX** IN YOUR GREEN SAND FACING

The smoother your mold surfaces, the cleaner your castings—and the less time and money you spend in finishing. These unretouched photographs show typical results being obtained by one large foundry through the addition of one-quarter to one-half of one per cent by weight of "Hercules" NVX to its green sand facing.

Prove for yourself how NVX can improve sand flowability and workability . . . give you better molds and better castings . . . with a production-scale test. 100-lb. lots for testing are available from Hercules at the 1000-lb. price.

HERCULES POWDER COMPANY

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NF51-3

By FRANCIS A. WESTBROOK

Vibration Isolation

Improves Machinery Efficiency

MANY high-production foundries, particularly in the automotive industry, are using resilient mountings as standard equipment, to absorb the vibration set up through the jolting and shaking of molding machines, shakeouts, tumblers, etc. These foundries have found that it not only saves the machines, but also prevents the transmission of vibration throughout the building and to other machines. Maintenance costs are consequently reduced.

Reasons for using resilient mountings with molding machines are: (1) to prevent the vibration of nearby machinery from disturbing the sand mold; (2) to reduce the transmission of vibration to other machinery and to the building; (3) to protect the foundations from jolts liable to chip and break the concrete and thus cause misalignment; (4) to prevent damage and fatigue of bearings, valves and other machine parts due to excessive vibration and (5) to aid in proper ramming of the sand.

Molding machines frequently are mounted on one of two types of rigid materials—either directly on concrete piers or on supporting steel frames which, in turn, rest on concrete foundations. Usually only one ⅝-in.-thick pad of a resilient material, such as rubber and a type made by Fabreeka Products Co., is used between the base of a machine and the concrete. More than two thicknesses may cause bounce and interfere with machine efficiency.

When a supporting steel frame is used, one ⅝-in.-thick pad is placed under the machine base. A second pad, which may be thinner, is also placed between the steel and concrete to provide adequate isolation against induced vibrations which might be transmitted to other places.

These statements are necessarily general because, for each installation, proper consideration must be given to the foundation, the soil beneath it, the type of mold being made, the strength of the machine base and the need of shielding adjacent machinery from vibration. If the nature of the work requires hard ramming and heavy jolts, less padding should be used than, for example, when simple molds are formed.

The user may, however, decide to sacrifice a small percentage of his molding machine efficiency by using the proper number of pads to achieve maximum isolation of vibration to protect some other equipment. Of course, in such cases the other equipment could be padded instead of overpadding the molding machine, but where a large number of machines and instruments are involved this might be unduly expensive, and the

(*Continued on page* 228)

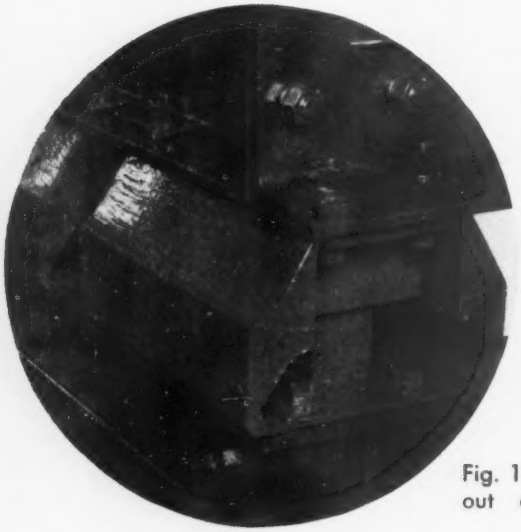
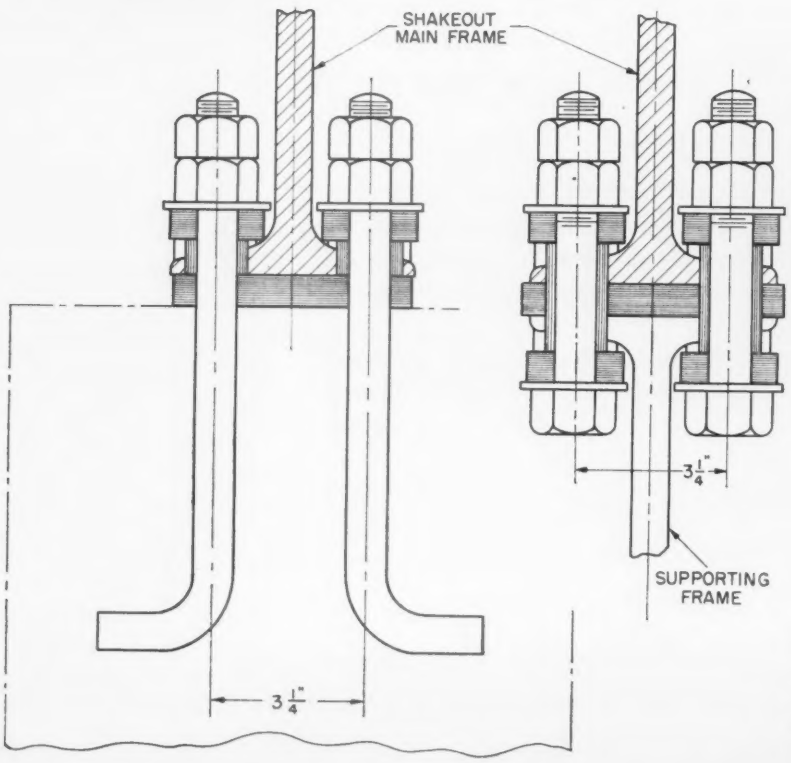


Fig. 1—Rubber mounting for shakeout absorbs excessive vibration



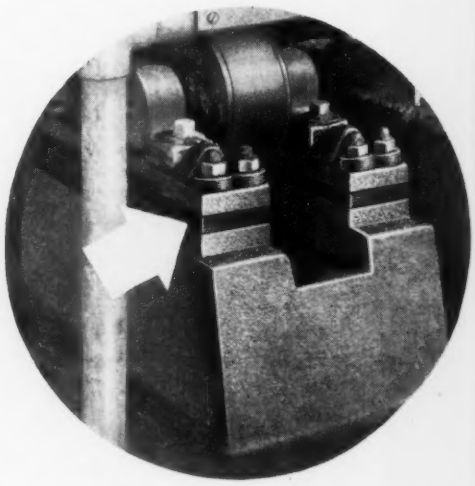
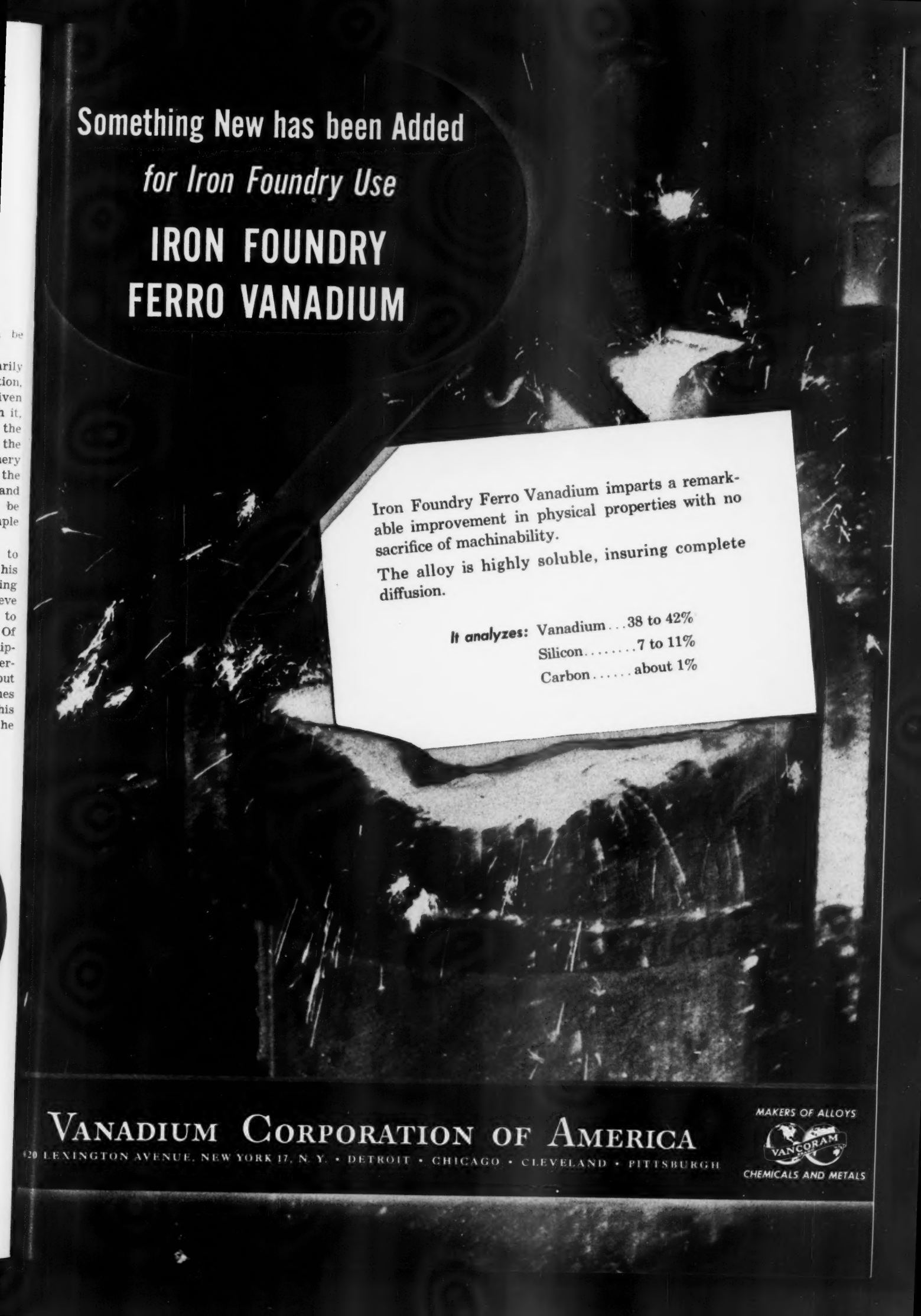


Fig. 2—Resilient pads, indicated by arrow, between base of tumbling barrel and foundation

Fig. 3—Resilient washers and bushings (shaded areas) used in anchoring foundry equipment. At left shows concrete foundation; at right mounting on steel support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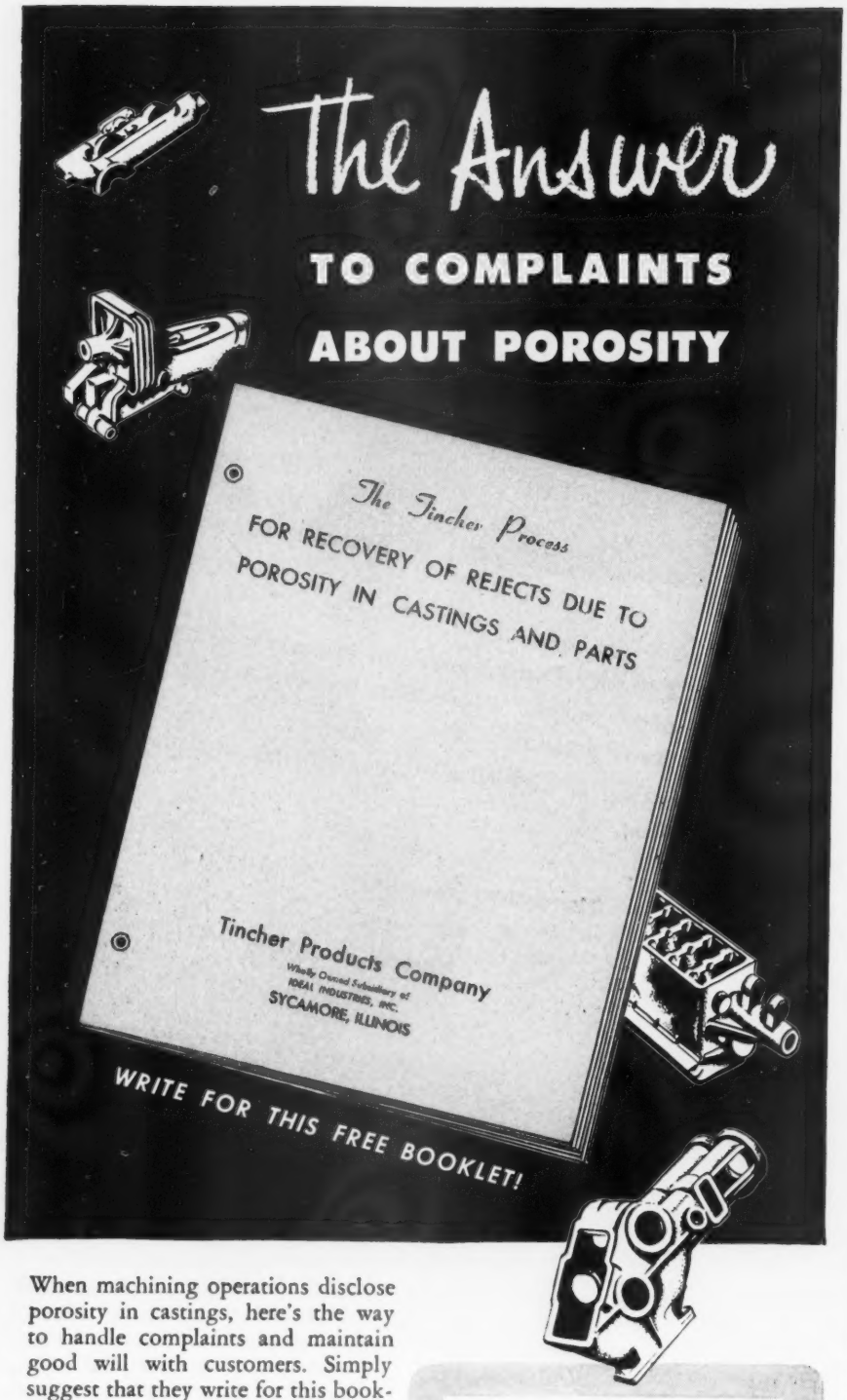

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(*Continued from page* 226)

question of what is best becomes economic. It is interesting to note, however, that pads of ⅞ and 1 in. thickness have been used under molding machines without undue loss of efficiency.

The bottom surfaces of molding machine bases must be smooth and flat to make full contact without cutting into the padding material at any point. The pads should support the entire base of the machine, and not just the corners. They must also conform to the shape of the base and not extend beyond it.

It is also necessary to prevent sand from seeping under the machine base; otherwise the machine will become tilted and the padding will deteriorate from abrasion. Asphalt cement, or other suitable compound, applied around the edges of the base will, so long as the pad does not extend beyond it, seal out the sand.

Washers and bushings are used with hold-down bolts to prevent the bridging of vibrations and to eliminate bolt fatigue. The manner in which they are used is shown in Fig. 3, a shakeout mounting. A resilient jarring plate pad 11/32-in. thick of similar material is frequently used with success between the table of a jolt molding machine and its foundation casting. In such applications the edges of the pad are cut to fit around the supporting frame.

Pads Increase Efficiency

It has been found by experience that when molding machines are padded as described, the length of the machine stroke can be extended safely so that fewer impacts are needed to form the molds.

Shakeout machines, which depend on shaking and vibration for their operation, obviously need resilient mounting to reduce their tendency to self-destruction, to protect the foundation and to minimize the transmission of vibration to other places. The pads, to be effective, must be of the same size as the bearing area, which must be flat and smooth.

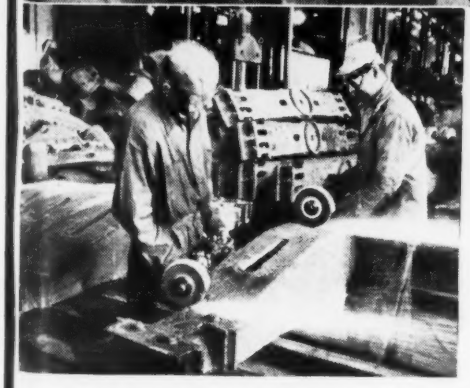
Shakeout machines are usually mounted on ⅝-in.-thick pads, either singly or with two pads of the same thickness with a smooth and flat steel plate between the two. Fig. 3 at left shows, for concrete foundations, the usual method of applying the pads under the machine, with washers of the same material under the steel washers beneath the nuts of the hold-down bolts. As will be seen resilient bushings are also used to insure the best results. Fig. 3 at right shows the mounting for a steel support.

A short time ago the Simplicity

(*Concluded on page* 230)

What's U. S. Rubber doing to grind railroad parts?

U.S. Royalite Wheels being used in a foundry to grind railroad car couplers.



Same foundry using U. S. Royalite® Wheels to smooth casting of a railroad bolster. This foundry has used "U. S." Wheels for 16 years.

Many a steel foundry across the country standardizes on U. S. Rubber's grinding wheels. Behind each "U. S." wheel are the great research facilities of "U. S." in bonds and abrasives, built up in the last 88 years. United States Rubber technicians can precisely engineer each wheel to your requirements. And if your operating conditions change, these technicians can quickly design a wheel to meet them. Write to address below.

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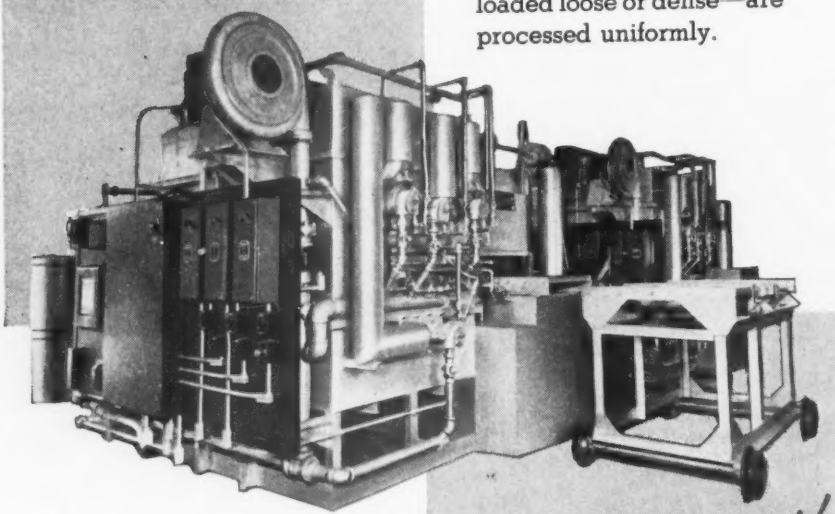

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The furnace can be operated automatically, or manually, by push-button controls. To save time, the temperature is built up between cycles to a point higher than necessary; then the normal operating temperature control is resumed after the cool parts enter the furnace. The quench tank handles the full load in one operation.

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(*Concluded from page 228*)

Engineering Co. developed the "rubber in shear" mounting to carry heavy units such as large shakeouts and scalping machines. This is said to be particularly effective for installations where ground conditions are so bad that the usual pads are not resilient enough to eliminate damaging vibrations. A view of this type of mounting is shown in Fig. 1.

Tumbling barrels also can be a source of serious vibration. The rotary operation of these heavy machines creates high frequency vibration which, if not damped out, may be transmitted to other equipment and to building structures. Either a single ⅝-in.-thick resilient pad or two such pads intercepted by a smooth flat steel plate can be used under the machine feet. Washers and bushings of the same material must be used to prevent bridging by the hold-down bolts. Fig. 2 shows the method of mounting.

Unless foundrymen have had considerable experience with such installations, and since each case of vibration isolation should generally be considered as an individual problem, it is worth while to consult with the recognized makers of resilient mountings before making any installations.

Sources of Illustrations

Fig. 1—Simplicity Engineering Co., Durand, Mich.
Figs. 2, 3—Fabreeka Products Co., Boston

Establishes Fellowships

International Nickel Co. has established two new fellowships in metallurgical engineering at Illinois Institute of Technology, Chicago 16. Each of the fellowships provides for two years' study leading to a master of science degree and carries an annual award of $1500 and tuition.

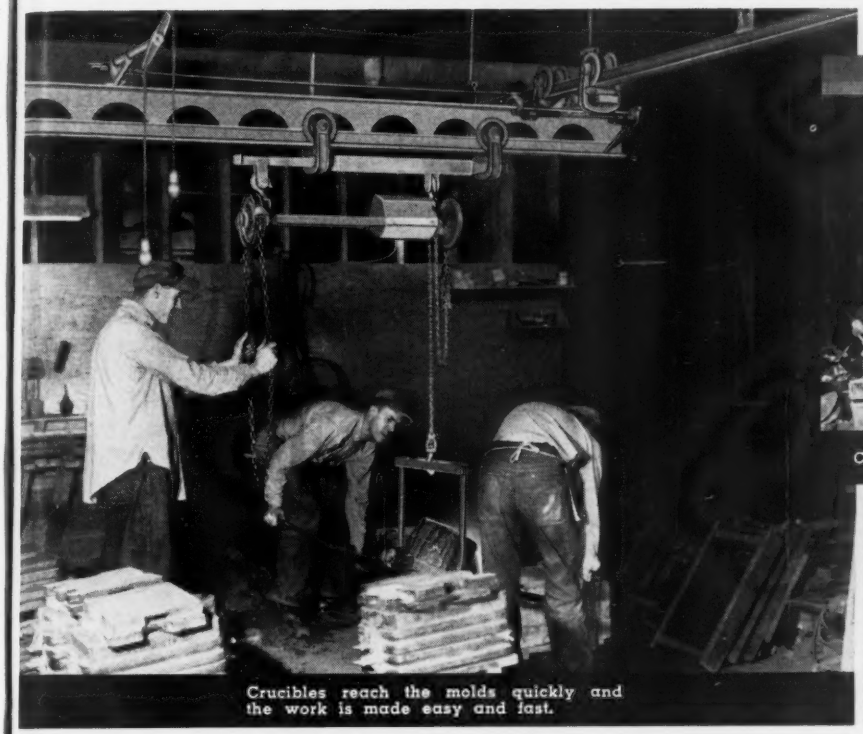
Purpose of the program, to begin in September, 1951, is to stimulate work in the fields of nickel, copper, and the platinum metals. Candidates must have a bachelor's degree in metallurgical engineering from an accredited engineering college. Awards will be based on personal qualifications, interest and scholarship.

Redesign Contest Opens

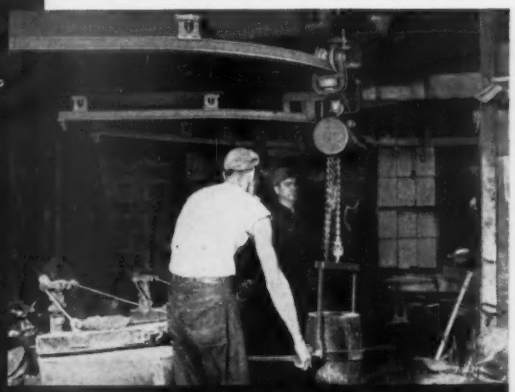
Gray Iron Founders' Society, 210 National City—East Sixth Bldg., Cleveland 14, has opened its 1951 redesign contest which gives recognition to the best redesign of parts for production in gray iron. Contest is open to engineers, designers or other interested persons, whether or not they are employees of member companies. Prizes totaling $350—first prize $200—will be awarded.

JUMPS FROM 3 HEATS TO 8 DAILY . . .

Tramrail System works wonders in 10-man foundry

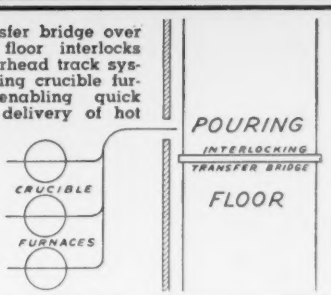


Crucibles reach the molds quickly and the work is made easy and fast.



Crucibles go direct to molds on Tramrail system.

The transfer bridge over pouring floor interlocks with overhead track system serving crucible furnaces, enabling quick efficient delivery of hot metal.



THE installation of a small inexpensive Cleveland Tramrail hand-propelled system at the Modern Brass Foundry, Columbus, Ohio, made a terrific difference in their operations. With no increase in man power, it made possible eight heats in a day instead of three, formerly usual. Despite more than double output, the men are now less fatigued at the end of a day.

No. 70 crucibles (240 lbs. capacity) are now used instead of No. 60 (200 lbs. capacity). It has been found that very little more heat is required to prepare 240 lbs. of metal than needed for 200 lbs. This provides a big saving in heat, which in itself goes a long way toward paying for the Tramrail equipment.

When they were considering installation of the overhead equipment, Modern Brass was quite concerned over a fear that it would not be fast enough and that they would be confronted with a large heat loss that would be troublesome. This fear has proven wholly unfounded. They have learned that working with Tramrail equipment is much faster than when pouring by hand.

Mr. R. E. Gleich, president, said as far as he was concerned the Cleveland Tramrail system paid for itself the first day in operation, because it so eased their work. After the first day he knew they could never afford to be without it. As a matter of fact, the equipment actually did pay for itself within a few weeks out of savings it brought about.

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● Easily hauls 10 cu. ft. in big hopper, or carries 1200 lbs. on sturdy 4-ft. flat-bed. Result: bigger loads per trip, less operator fatigue, more loads per day.

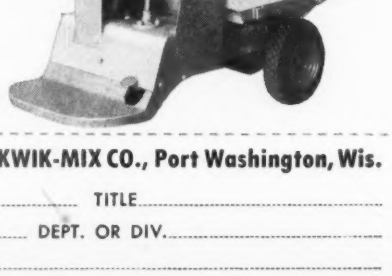
● *Standard-make*, 4 h.p., 4-cycle, gasoline engine takes full load up 20% ramps or grades. Handy 33" width clears narrow aisles and doorways . . . turns in own length.

● Moto-Bug has positive steering, direct to dual rear wheels. Large steering wheel with 3.6 to 1 gear ratio provides handling ease.

● Riding step, optional, plus positive steer arrangement, and forward and reverse power, let operator ride while traveling, spotting, and backing up.

● Dual steering wheels are standard equipment . . . dual drive wheels optional, for plenty of rubber-tired traction, flotation and handling ease on or off pavement.

● In addition to hopper and flatbed platform, Moto-Bug also has fork lift attachment and scraper blade . . . saves time, labor on all kinds of material-handling jobs. All attachments are quickly interchangeable.



Send for complete Moto-Bug facts to: **KWIK-MIX CO., Port Washington, Wis.**

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STREET .....

CITY ..... STATE .....

FO KM135

KWIK-MIX COMPANY
PORT WASHINGTON, WIS.
(Koehring Subsidiary)

Steelmaking for Castings

(*Continued from page 77*)

for the last of the scrap and the pig

The charge is melted as rapidly as possible with a full flame, burning the maximum amount of fuel. The lime and the coke or graphite are soon covered by the liquid metal which quickly absorbs carbon from the carbonaceous material. Some little time after all the metal is melted, the lime "comes up"—that is it rises to the slag, into which it gradually is absorbed. The bath then should be stirred well with bars, and the first test taken. The amount of ore required to bring the carbon to the desired point is estimated from the carbon content of this test, and when the metal has reached a fairly high temperature, the ore is charged.

When no pig iron is used and all the carbon in the bath is obtained from the scrap and coke or graphite, the order of charging is the same; that is, the plate scrap is spread on the bottom, the lime and coke distributed over it, and the rest of the scrap tops off the heap. With no pig iron to give partial protection to the scrap, more FeO is produced in melting the charge than in regular practice. As the bath at first lies quietly, the rather fluid slag reflects the heat to such an extent that the operator must be unusually vigilant to avoid "touching" the roof.

Slag Foams Vigorously

When the charge has melted down to the layer of carbonaceous material, a vigorous reaction takes place between the FeO of the slag and the carbon of the coke. The large volume of CO thus suddenly produced makes the slag foam up vigorously. As heat passes through a foaming slag very slowly, the roof may then be damaged unless the fuel input is cut down promptly. When the foaming finally ceases, a normal carbon boil begins, and the heat thereafter can be handled in the same way as in regular practice. It is partly because of the difficulty of handling these seriously foaming slags that steel foundry operators prefer to use at least 10 per cent pig iron in basic open-hearth charges, instead of obtaining all the carbon from coke or graphite.

The ore addition should be figured to eliminate carbon at a rate of from 15 to 50 points (0.15 to 0.50 per cent) per hour—a drop of 40 points (0.40 per cent) per hour is probably a fair average in steel foundry operation. As in acid furnaces, the boil should be allowed to die out of its own accord, and the best practice is to add no ore less than 1½ hours before

blocking the heat. When the carbon has reached the desired point, the Si will have been reduced to 0.01 per cent or less, and the Mn to between 0.05 and 0.35 per cent, depending upon the content in the original charge. The P will then be between 0.005 and 0.04 per cent, and the S from 0.02 to 0.04 per cent. The elimination of the impurities in a normal heat is well shown in Table II.

If the lime-silica ratio in the slag and its iron oxide content are kept high, the elimination of phosphorus from the metal will proceed at a satisfactory rate. To reduce the sulphur content is another matter. Sulphur elimination is favored by a high lime-silica ratio, and also by a high residual manganese content in the bath. If the FeO in the slag is high, as it should be to secure proper elimination of phosphorus, it oxidizes manganese out of the bath, and makes the residual manganese content low. Thus the high FeO content that gives satisfactory removal of phosphorus tends to restrict the elimination of sulphur. The surest way to obtain steel with a low sulphur content is to use scrap, pig iron and carbonaceous material that contains a minimum of that impurity.

A satisfactory rate of phosphorus elimination cannot be secured if the slag is allowed to become thick and gummy. As the carbon is boiled out of the steel and the temperature of the bath raised to the proper point, the fluidity of the slag is maintained, without lowering its basicity, by additions of fluorspar (calcium fluoride). This material, usually in particles about the size of builder's gravel, is spread over the slag with shovels. Several additions of spar may be required to keep the slag properly fluid, but no more than that needed for the purpose should be used.

Re-boil—When the carbon content of the bath is dropping so fast as to approach the desired point before the slag has been properly "shaped up," and the bath brought to the required temperature, the oxidation of carbon is temporarily arrested by charging spiegel or pig iron. The manganese or silicon so added then reacts with the FeO of the slag in preference to the carbon, so that the boil ceases and for a period of from 30 minutes to an hour the bath is quiet. After that the normal boil begins again and soon builds up to a lively reaction. This procedure is known as a "re-boil." In a 100-ton heat, a typical addition consists of 1000 to 2000 lb of spiegel, introducing about 0.10 to 0.20 per cent Mn and 0.02 to 0.05 per cent C, or of 2000 to 4000 lb of pig iron

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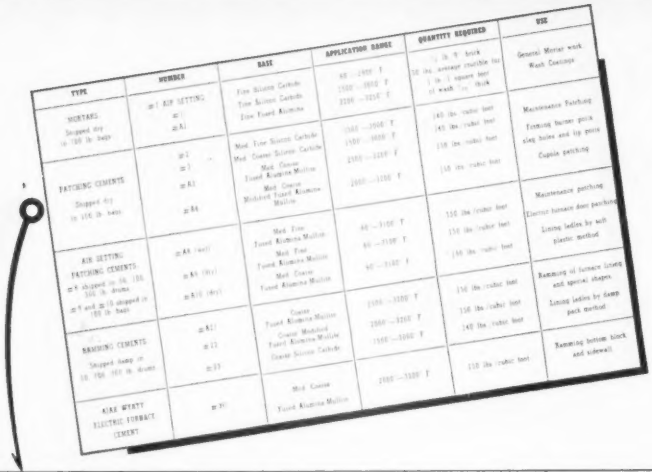
NATIONAL REFRACTORY CEMENTS



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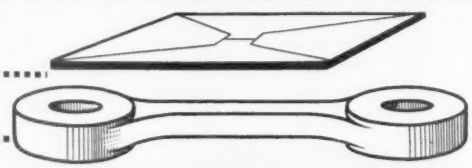

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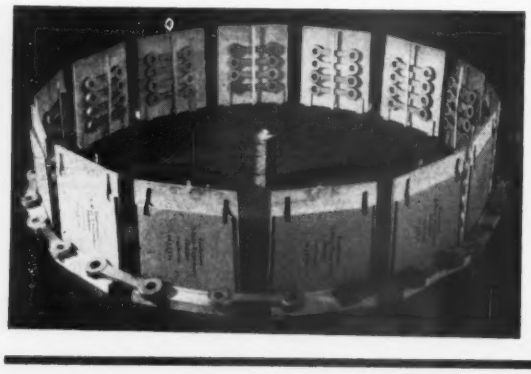
improves foundry practice and production

Compared with X-ray radiography, radium radiography is new, but its peculiar advantages have been finding increasing favor with steel foundries. The first commercial radiograph with radium was made in 1930—and by 1950 250 steel foundries throughout the country were using radium radiography. The constant activity of radium, the even dispersion of its rays with a minimum of scattering; the portability of the equipment and simplicity of operation all combine to make radium radiography an economical, non-destructive method of testing. Write today for case histories and additional information. *Your requirements promptly supplied.*

Illustration shows 60 steel castings being photographed simultaneously. The gamma rays, flying in all directions, go through all the castings at once, making 60 exposures of the 60 castings



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which adds about 0.01 to 0.03 per cent Si and 0.04 to 0.08 per cent C.

While the boiling action is suspended, the slag is made properly fluid by additions of spar, and the metal brought up to temperature. Some operators prefer to use a re-boil addition on every heat, and follow it with the normal block when the carbon has reached the desired point, while others dispense with the re-boil and use only a block except when the carbon gets too low while the slag is still heavy.

Blocking—When the carbon content has been reduced to a little below that required in the finished steel, the further oxidation of carbon is stopped by charging 15 per cent ferrosilicon, silico-manganese or spiegel. Soon after this "blocking" addition is made, boiling stops and the slag flattens out smooth and quiet. About 10 or 15 minutes are required to melt the alloys, and the heat is then ready to be tapped. Were the metal kept in the furnace, boiling would recommence in about 20 to 45 minutes.

As 15 per cent ferrosilicon is a heavy material that readily sinks through the slag, many operators prefer it as a block. In a 100-ton heat,

TABLE III—Heat with Ferrosilicon as Block

Charge	Lb
Pig iron	7,500
Forgings	9,000
Heavy melting steel	17,500
Punchings	8,000
Cast steel scrap	8,000
Total	50,000
Lime	2,500

Log of Heat

Time	Item
11:40-1:30	Charge
3:30	Melted
3:30	Test No. 1: C 0.58 per cent
3:35	500 lb ore
3:50	Test No. 2: C 0.42%, Mn 0.21%
4:00	Test No. 3: C 0.35%, Mn 0.20%
4:00	750 lb lime
4:10	Test No. 4: C 0.29%
4:15	75 lb fluorspar
4:20	Test No. 5: C 0.26%, Mn 0.21%
4:23	400 lb 15 per cent ferrosilicon
4:33	Tap

Time of heat 4 hours 53 minutes
510 lb 50 per cent FeSi added to stream, 294 lb 80 per cent FeMn added to ladle, 15 lb petroleum coke added to ladle.
Final analysis: C 0.28%, Mn 0.69%, Si 0.40%, P 0.022%, S 0.027%.

From C. W. Briggs, *The Metallurgy of Steel Castings*, page 17

100 to 3000 lb of this alloy introduces 0.07 to 0.22 per cent Si into the bath, which is enough to protect the carbon effectively from oxidation. Other authorities believe that a manganese block produces better steel, and recommend the use of spiegel or silico-manganese. Particularly when the heat is blocked with the latter alloy, it is thought that the $MnO.SiO_2$ inclusions formed by its reaction with FeO float out of the

steel more readily than the SiO_2 produced by a ferrosilicon block.

The heats shown in detail in Tables II and III illustrate the use of 15 per cent ferrosilicon as a block, while those in Tables IV and V were blocked with spiegel. A re-boil addition of spiegel also was used in the heat shown in Table IV.

Phosphorus Reversion—When ferrosilicon is used as a re-boil or a blocking addition, the SiO_2 produced by its oxidation may so lower the basicity of the slag that some of the P_2O_5 will be reduced and the phosphorus will re-enter the steel. A certain amount of this "phosphorus reversion" may also result from additions of manganese alloys. To counteract this tendency, the basicity of the slag may be maintained by charging extra lime when the blocking additions are made.

Phosphorus reversion also takes place in the ladle, when SiO_2 absorbed from the ladle lining enters the slag and lowers its basicity. As only a comparatively thin layer of slag is kept on top of the steel in the ladle, it does not require a great deal of silica to change the composition quite a good deal, and it practically always will be found that the phosphorus of the last portion of the heat poured is considerably higher than that of the steel when it was tapped from the furnace. Tables II and V illustrate this.

When only silicon alloys are used for blocking, the required amounts of manganese and silicon are added to the steel as the heat is tapped, by shoveling or chuting the ferroalloys, crushed to nut size, into the stream of metal in the spout. If

TABLE IV—Use of Spiegel as Reboil Addition

Charge	Lb
Pig iron	25,000
Heavy melting steel	25,000
Forgings	10,000
Cast steel returns	40,000
Total	100,000
Lime	6,000
Fluorspar	400

Log of Heat

Time	Item
10:00	Melted (time, 7 hours 55 min.)
10:00	Test No. 1: C 0.68%
10:00	800 lb ore
10:30	Test No. 2: C 0.55%, Mn 0.23%
11:00	Test No. 3: C 0.41%, Mn 0.20%
11:00	600 lb spiegel
11:30	Test No. 4: C 0.30%, Mn 0.25%
12:00	Test No. 5: C 0.19%, Mn 0.27%
12:13	Test No. 6: C 0.15%
12:13	2000 lb spiegel
12:18	400 lb silicomanganese
12:28	Tap

350 lb 50 per cent FeSi added to ladle, 20 lb anthracite coal to stream.
Ladle analysis: C 0.25%, Mn 0.74%, Si 0.35%, P 0.02%, S 0.024%.

From C. W. Briggs, *The Metallurgy of Steel Castings*, page 18

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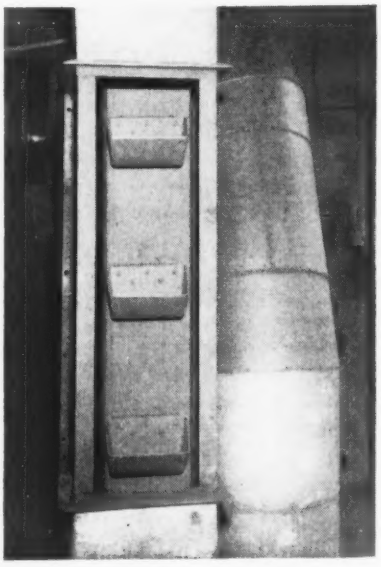

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the heat is blocked with spiegel or silicomanganese, a large part of the manganese so added remains in the steel, and the ladle addition is considerably reduced. An example of this practice is shown in Table V.

As in acid practice, if the ferroalloys do not contain enough carbon to bring the content to the required point, crushed coke or fine anthracite coal in bags may be tossed into the stream of steel as it enters the ladle. The amount of carbon so obtained from a given weight of carbonaceous material varies widely from heat to heat, however, and only small adjustments in the composition should be made in this way.

Pigging Up—Some heats will melt down too low in carbon to permit the slag to be shaped up and the steel brought to temperature, without reducing the carbon content to a figure very much below that required in the finished steel. To work these heats, enough pig iron is charged immediately after the steel is melted, to raise the carbon a number of points. The pig also adds a good deal of silicon, which protects the carbon from oxidation for some time, so that "pigging up" a heat has much the same effect as a re-boil. The amount of pig added, however, is usually much greater than is used for a re-boil, because the carbon must be raised high enough to allow a proper boil to be produced, without too greatly reducing the carbon content of the heat.

TABLE V—Heat with Spiegel as the Block

Charge	Lb
Basic pig iron	24,300
Foundry scrap	56,400
Low phosphorus scrap	31,600
Heavy melting steel	10,300
Turnings	5,400
Total	128,000
Graphite	800
Lime	8,300

Log of Heat

Time	Item
5:05	Start charging scrap
8:26	Finish charging scrap
8:55	Finish charging pig
12:00	Melted
12:00	Test No. 1: C 0.55% (estimated)
12:15	500 lb ore
12:30	Test No. 2: C 0.57%, Mn 0.23%, S 0.023%
12:45	Test No. 3: C 0.40%
1.03	Test No. 4: C 0.34%
1:17	Test No. 5: C 0.29%, Mn 0.24%
1:40	Test No. 6: C 0.22%
1:56	Test No. 7: C 0.18%, P 0.008%, S 0.014%
1:57	2560 lb spiegel
2:05	Tap

Time of heat 9 hr

1152 lb 50 per cent FeSi added in spout, 412 lb 80 per cent FeMn added in spout, 128 lb Al added in ladle.

1200 lb fluorspar used in heat.

Analysis of "kill test": C 0.27%, Mn 0.46%, Si 0.031%, P 0.010%, S 0.015%.

Final analysis: C 0.30%, Mn 0.66%, Si 0.37%, P 0.013%, S 0.015%.

From a private communication.

Deoxidation—Liquid steel contains small amounts of nitrogen absorbed from the furnace gases and present as an iron nitride. In open-hearth furnaces, however, the heavy layer of slag protects the metal from contact with the furnace atmosphere enough to prevent the absorption of more than very small quantities of nitrogen. Hydrogen is also held in solution in liquid steel, and it has been proved that it dissolves atomically. Slaked lime, excessive amounts of moist rust, ice and snow, oil, etc., on the scrap, moisture introduced on wet ferroalloys, and the steam used to atomize oil fuel, are the principal sources of the hydrogen absorbed by the steel.

It is believed that nitrogen and hydrogen will not of themselves form bubbles in the molten metal, but if other gases are generated in the steel, both nitrogen and hydrogen will at once come out of solution, enter the incipient bubbles and greatly enlarge them. As already mentioned, to keep the amount of dissolved gas in the metal as low as possible, a vigorous carbon boil should be maintained for a considerable length of time, so that the CO evolved may sweep the other gases out with it.

Deoxidizers Are Necessary

Oxygen is believed to be held in solution in steel, not as elemental oxygen, but as iron oxide; the amount that can be retained in solution increases as the temperature of the metal rises. CO and CO_2 are known to be insoluble, or nearly so, but the former is often generated in large quantities by the reaction between C and dissolved FeO. At any given temperature, the carbon of the steel is in equilibrium with an amount of dissolved FeO that is the greater, the lower the carbon content and the higher the temperature. As the metal cools, however, solubility of the FeO decreases, and the tendency for it to react with the C increases rapidly. Steel of a given carbon content, containing an amount of FeO that is in equilibrium with the C at high temperature, therefore, will form quantities of CO as it cools in the molds, and any other gases remaining in solution in the metal will enter the incipient bubbles of CO and increase their size. If this is allowed to happen, the solidified steel will contain numerous holes formed by trapped gases. It is necessary, therefore, to add deoxidizers that will so reduce the amount of FeO remaining in the steel that no CO will be formed.

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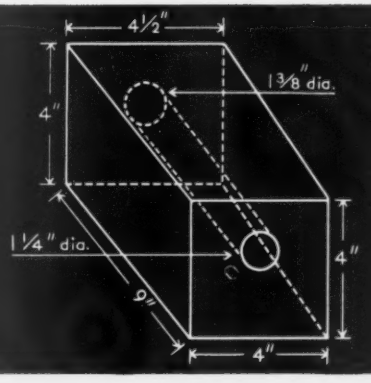

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the oxygen from the FeO and convert it into compounds that do not react with C and form CO. The lower the carbon content of the steel and, therefore, the larger the amount of FeO dissolved in it, the more oxygen must be converted to these inactive forms.

The higher the FeO content of the slag in the furnace, too, the higher is the amount of FeO in the metal. Part of it is reduced during the carbon boil, by the reaction of $FeO + C = CO + Fe$, and as the boil progresses, the FeO in the slag decreases, and that in the steel approaches the amount that is in equilibrium with the carbon at the existing temperature—in other words, the boil ceases.

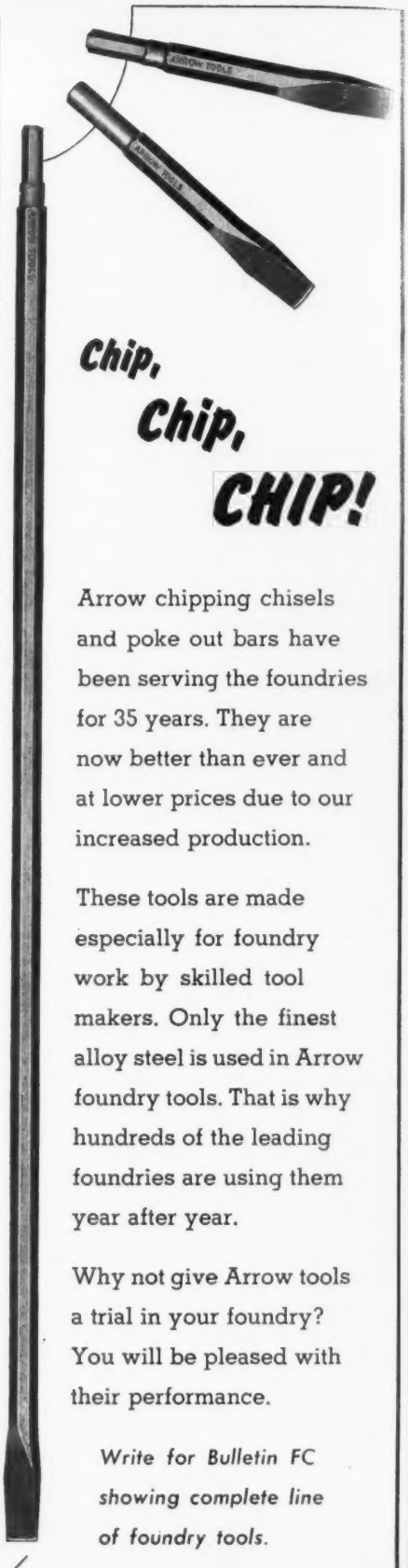
The deoxidizers generally used to reduce the FeO in the steel to safe proportions are Si, Mn and Al. These elements react with FeO in accordance with the well known equations,

$$Mn + FeO = MnO + Fe$$
$$Si + FeO = SiO_2 + 2\ Fe$$
$$2\ Al + FeO = Al_2O_3 + 3\ Fe$$

Manganese is the least effective deoxidizer of the three, silicon much more so, and aluminum the most powerful. In medium carbon steel such as is chiefly used for castings, a Si content of 0.25 per cent will reduce the FeO to a point where it will not react with C. To be on the safe side, steelmakers usually use 0.35 per cent Si in steel intended for pouring castings.

Manganese alone would probably not reduce the FeO content to a safe figure, but at least 0.50 per cent Mn generally is used in connection with the Si, partly for its effect as a deoxidizer and partly because it converts the FeS present in the steel to MnS, according to the reaction $FeS + Mn = MnS + Fe$. Part of the MnS floats into the slag, where some of the S is converted to SO_2 and lost, and some is held in solution. The MnS that remains in the steel takes the shape of rounded globules which have little effect on the properties of the metal, while FeS tends to form stringers between the crystals, which make the metal weak at red heat—that is, red-short.

When heavy castings are to be poured in dry sand molds, Si and Mn in proper amounts will deoxidize basic open-hearth steel enough to prevent the evolution of CO and the formation of gas holes as the metal solidifies. For smaller castings, however, and especially for green sand work, a stronger deoxidizer which will eliminate much more of the FeO is essential. For many years Al in amounts of from 2 to 2½ lb per ton of steel (0.1 to 0.15 per cent) or even slightly more, has been used for this



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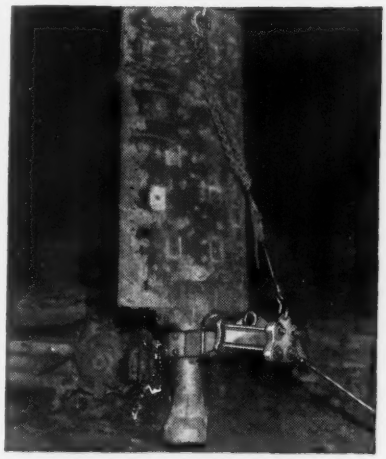

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purpose. It is always added by tossing it into the stream of metal pouring into the ladle after the silicon and manganese alloys have been chuted in, and when the ladle is about one-third full.

Use of Oxygen—Since cheap oxygen became available to industry, it has been tried out in both open-hearth and electric furnace operation, as a means of securing high melting rates and rapid elimination of carbon from the metal. As the amounts used are too large to be economically supplied in cylinders of the usual 244-cu ft size, the oxygen is piped at moderate pressures from a central storage station to the furnace floor. Means are provided to measure the quantities taken from the lines.

To secure faster melting rates in open-hearth furnaces, oxygen is piped to the oil or gas burners and fed in with the fuel in amounts sufficient to produce a hotter, sharper flame than can be obtained with air or steam alone. The oxygen is turned on for only a comparatively short time, usually toward the end of the melting period. As an alternative method, a steel pipe connected to the lines is introduced through one of the charging doors, and the oxygen directed against the bigger pieces of metal, much as an oxygen lance is used in cutting up heavy scrap. A large amount of iron is thus oxidized to FeO, and much of it is carried along with the waste products of combustion, in the form of dense reddish fumes. As might be expected, this greatly increases the rate of attack on the silica walls and roof of the furnace. When the oxygen is fed in at the burners, rather less oxide fume is produced.

When high proportions of light scrap are to be melted, and pig iron largely replaced in the charge by coke or graphite, the oxygen sometimes burns up part of the carbonaceous material before it can be absorbed in the bath. The heat will then melt down low in carbon, and may have to be pigged up to allow time to get the slag in proper shape. When this happens, the time gained in melting down may be more than balanced by that lost in working the heat.

The second method is to use the oxygen after the steel is melted, to speed up the rate of carbon elimination. A ½-in. steel pipe is introduced through one of the charging doors, is thrust deeply into the bath, and is moved about as a stirring rod would be. The pipe rapidly melts away and is replaced as often as necessary. Though primarily intended to speed up carbon elimination,

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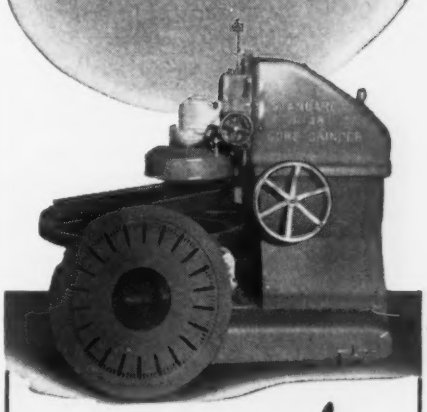

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this method also raises the temperature of the bath markedly, because the oxygen oxidizes a great deal of iron as well as carbon, and thus generates large amounts of heat. Just as in using the oxygen lance to increase the melting rate, heavy clouds of iron oxide fume are produced, and are carried out of the stack with the products of combustion. The brickwork of the melting chamber, slag pockets and checkers therefore is attacked much more severely than in normal practice.

Use of oxygen by any of these methods usually reduces the time required to make a heat, and correspondingly increases the output of the furnace. Against this advantage must be balanced the increased maintenance expense due to the shorter life of the refractories when exposed to the oxide fumes. When first introduced in the steel foundry industry, oxygen was tried out extensively in a number of shops, and generally its use resulted in a considerable increase of output. However, the method has not yet been widely adopted in steel foundries using open-hearth furnaces.

Lost Through Oxidation

The details of four typical basic open-hearth heats are shown in Tables II, III, IV and V. The first two illustrate the use of low percentage ferrosilicon as a block. In these heats all the Mn was added to the steel in the ladle, and a large proportion of it was recovered. Of the total Si added, however, approximately one-third was lost by oxidation; a test taken just before tapping would have shown that much of the Si in the alloy added as a block had been oxidized by reaction with the FeO of the bath.

Table IV shows a heat in which a re-boil addition of spiegel was made an hour after melt-down, spiegel was used for a block, and all the Mn was added in the furnace. The practice shown in Table V was similar, except that the re-boil was omitted, and part of the Mn was added in the furnace (in the block), part to the stream of metal in the spout. In both of these heats, most or all of the Si was added in the ladle, and the recovery was high. As would be expected, about half of the Mn contained in the spiegel block was lost, as shown by the analysis of the "kill test" in Table V, taken just before the heat was tapped.

In figuring the final additions to basic heats, a melting loss of 6 to 8 per cent of the metallic charge should be counted upon. The greater the proportion of light steel scrap in the

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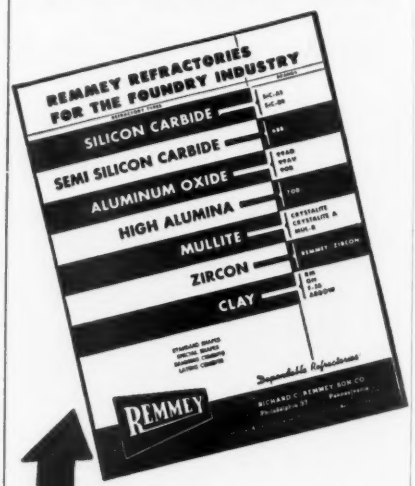

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charge, the higher will be this loss. Half of the weight of iron ore used and about 70 per cent of that of the graphite should be added to the weight of metals charged.

References

1 C. W. Briggs, *Metallurgy of Steel Castings*, p. 8.

Industry Advisory Committees Appointed by OPS

Fifteen representatives of the steel castings industry have been appointed by the Office of Price Stabilization, Washington, to constitute an advisory committee to that body. Known as the Carbon and Low-Alloy Castings Industry Advisory Committee, its members are:

Frank M. Robbins, president, Ross-Meehan Foundries, Chattanooga, Tenn.
N. K. Anderson, president, Alloy Steel & Metals Co., Los Angeles.
B. J. Gross, president, Key Co., East St. Louis, Ill.
Claude L. Harrell, vice president, Sterling Steel Casting Co., East St. Louis, Ill.
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E. L. Altenburg, vice president, Atlas Steel Casting Co., Buffalo.
John B. Fleeger, vice president, Oklahoma Steel Castings Co., Tulsa, Okla.
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T. F. Dorsey, president, Pittsburgh Steel Foundry Corp., Glassport, Pa.
R. C. O'Kane, vice president, Buckeye Steel Castings Co., Columbus, O.
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J. D. Hagans, works sales manager, Ohio Steel Foundry Co., Springfield, O.

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C. A. Gutenkunst Jr., president, Milwaukee Malleable & Grey Iron Works, Milwaukee.
C. S. Anderson, president, Belle City Malleable Iron Co., Racine, Wis.
R. C. Becherer, general manager, Link-Belt Co., Indianapolis.
C. E. Brust, executive vice president, Eastern Malleable Iron Co., Naugatuck, Conn.
E. E. Burk, vice president, Lancaster Malleables & Steel Corp., Lancaster, N. Y.
R. G. Parks, controller, National Malleable & Steel Castings Co., Cleveland.
James E. O'Brien, Fanner Mfg. Co., Cleveland.
F. O. McDermott, International Harvester Co., Chicago.
John A. Wagner, president, Wagner Malleable Iron Co., Decatur, Ill.
A. H. Zick, secretary-treasurer, Auto Specialties Mfg. Co., St. Joseph, Mich.
Gordon E. Nash, Albion Malleable Iron Co., Albion, Mich.
W. E. Butts, president, General Metals Corp., Los Angeles.
F. C. Tuttle Jr., president, Belcher Malleable Iron Co., Easton, Mass.
C. I. DeShong, president, Oriskany Malleable Iron Co., Oriskany, N. Y.

Foundry Equipment and Facings—J. L. Thies, vice president, the Fenton Foundry Supply Co., Dayton, O., is a member of the Foundry Equipment and Facings Advisory Committee to the National Production Authority. Mr. Thies' name inadvertently was omitted from the list of members furnished by NPA and presented in May FOUNDRY, p. 136.

This V-25 Electric Vibrator on hopper supplying bucket elevator keeps material flowing freely, without surges, and without periods of coming "short".

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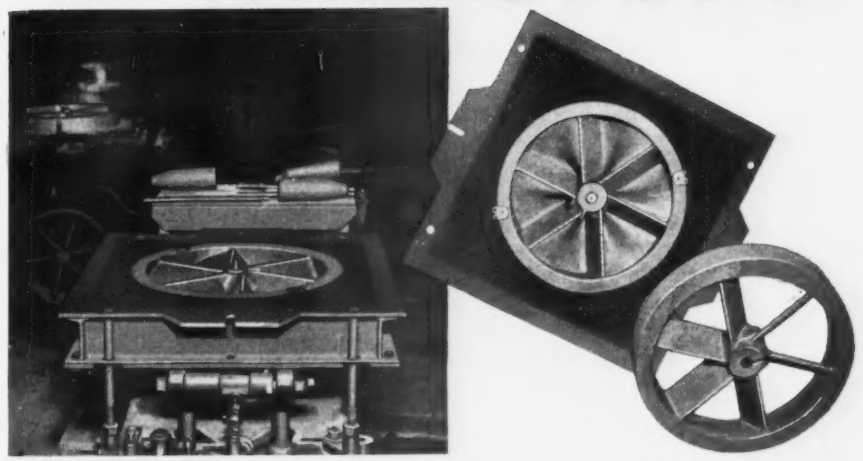

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...TRADE PUBLICATIONS...

For More Details on these Items Use Reply Card—Page 199

MOLDING MACHINES: SPO Inc., 6449 Grand Division Ave., Cleveland 25—Bulletin 500, covering jolt rock-over pattern draw machines, contains dimensions, capacities, weights, vibrator size and other data, as well as photographs and line drawings showing construction and operating features.
For More Details Circle No. 90—Page 199

VENTILATION: American Wheelabrator & Equipment Corp., 505 South Byrkit St., Mishawaka 2, Ind.—First issue of a new periodical, "Industrial Ventilation," contains illustrated case histories on the application of cloth-tube filters to dust control problems in various industries. Included is a technical discussion on collecting efficiencies.
For More Details Circle No. 91—Page 199

SOFT BLASTING: Pangborn Corp., 1400 Pangborn Blvd., Hagerstown, Md.—Bulletin covers a portable soft abrasive blast cleaning machine and tells how such grits as corn cobs, walnut shells, peach pits, sawdust, etc., are used to blast grease and dirt from machines and parts without damaging the surface material of the machine or part.
For More Details Circle No. 92—Page 199

OIL BURNER: Hauck Mfg. Co., 106 Tenth St., Brooklyn 15, N. Y.—Catalog 412 illustrates and describes a long nose type, low-pressure, air-atomizing oil burner designed to burn any grade of fuel oil. It is intended for use where the burner nozzle must extend into the furnace for some distance so that the flame will start farther away from the firing wall of the furnace.
For More Details Circle No. 93—Page 199

EQUIPMENT: Yale & Towne Mfg. Co., Philadelphia Division, 11000 Roosevelt Blvd., Philadelphia 15—Catalog contains descriptive and application data on company's gas and electric fork lift trucks, motorized hand trucks, hand lift trucks, and hand and electric hoists. A section describes truck attachments.
For More Details Circle No. 94—Page 199

MOTOR CONTROLS: Electric Machinery Mfg. Co., Minneapolis 13—Bulletin 3100-PRD-204, describing polarized field frequency controls (standard interrupting capacity type) for synchronous motors, includes ratings, weights, dimension drawings, wiring diagrams, layout drawings and specifications.
For More Details Circle No. 95—Page 199

PNEUMATICS: Miller Motor Co., 4027 North Kedzie Ave., Chicago 18—"The Joint Industry Conference Pneumatic Standards for Industrial Equipment," adopted as the desirable quality requirements to be specified by users of pneumatic machinery and equipment, are reproduced in a 12-page booklet with sample circuit, glossary of terms, two pages of standard symbols, and a comparison showing how the company's air cylinders meet the standards.
For More Details Circle No. 96—Page 199

VALVES: Ross Operating Valve Co., 120 East Golden Gate, Detroit 3—Catalog covers straightway, three-way, four-way and four-way five port units in various sizes of hand, foot, solenoid, pilot, remote control, cam, speed control, shut-off, quick exhaust, and miscellaneous valves.
For More Details Circle No. 97—Page 199

CARBIDE TOOLS: Atrax Co., Dept. C, Newington 11, Conn.—Catalog shows company's complete line of solid tungsten carbide rotary files, reamers, end mills, boring bits, grinding tools, knurls, and small, chatterless countersinks, as well as a new line of tungsten carbide drills.
For More Details Circle No. 98—Page 199

FLAME SAFEGUARDS: Minneapolis-Honeywell Regulator Co., Industrial Division, Wayne & Windrim Aves., Philadelphia 44—Catalog 9601 is a manual on flame failure protection for industrial applications. Information on 24 different safeguard systems is included.
For More Details Circle No. 99—Page 199

FILTERS: Dollinger Corp., 11 Centre Park, Rochester 3, N. Y.—Bulletin B-1A describes, illustrates and gives applications and specifications for pipe line filters, including pressure and vacuum types, for air and other gases.
For More Details Circle No. 100—Page 199

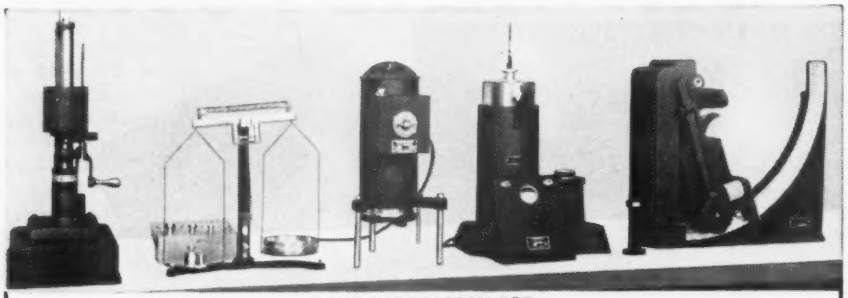
MOTION STUDY: Bell & Howell Co., 7100 McCormick Rd., Chicago 45—"Measure Time Accurately," a new booklet, is designed to acquaint executives with the advantages of the film method of time and motion study.
For More Details Circle No. 101—Page 199

HEATERS: Dravo Corp., Heating Dept., Fifth & Liberty Aves., Pittsburgh 22—Bulletin 526 describes direct-fired space heaters in a range of gas or oil fired models with outputs from 400,000 to 2 million Btu per hr.
For More Details Circle No. 102—Page 199

CLAMSHELL BUCKETS: Blaw-Knox Division, Blaw-Knox Co., 2097 Farmers Bank Bldg., Pittsburgh 22—Bulletin 2373 discusses the use, maintenance, and care of clamshell buckets.
For More Details Circle No. 103—Page 199

LIFT TRUCKS: Silent Hoist & Crane Co., 885 63rd St., Brooklyn 20, N. Y.—Bulletin 77 describes company's line of heavy duty fork lift trucks.
For More Details Circle No. 104—Page 199

SAND CONTROL INCREASES PRODUCTION



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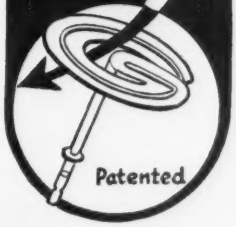

CLEVELAND Chaplets

CMC

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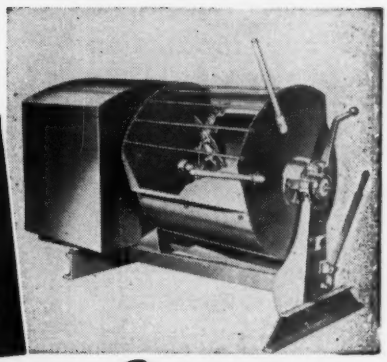

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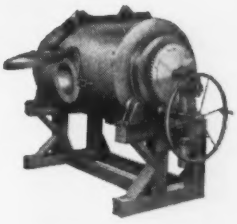

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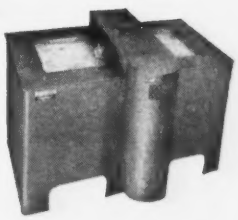

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"Armor plate" foundry floors with EMERI-CRETE

made with CORTLAND EMERY AGGREGATE

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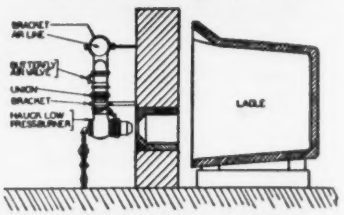

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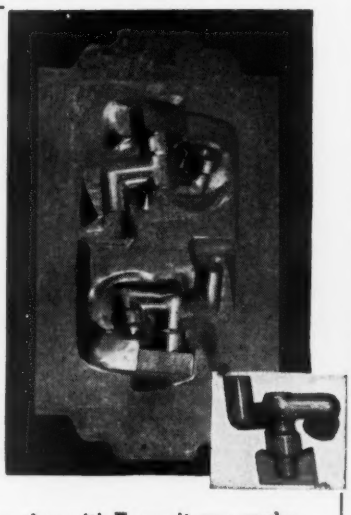

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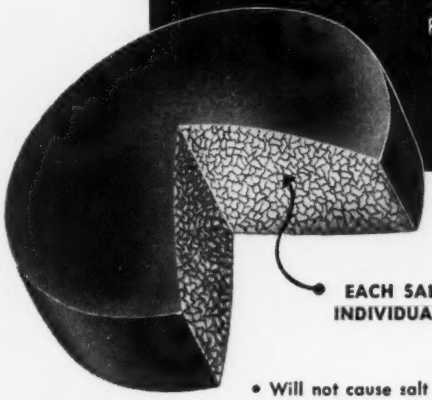

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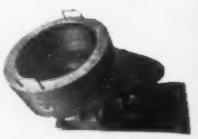

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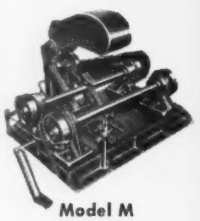

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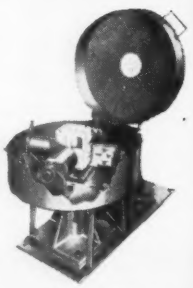

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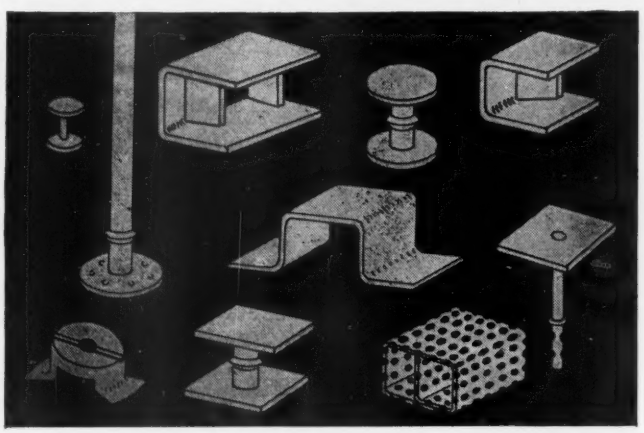

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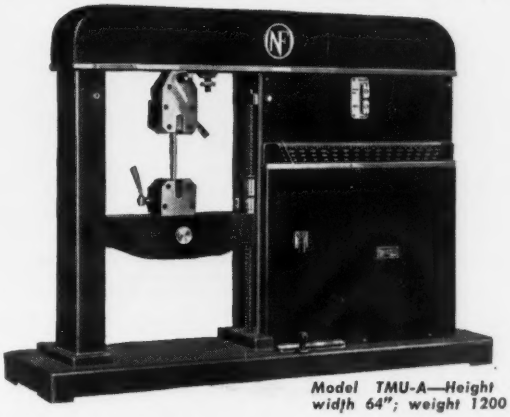

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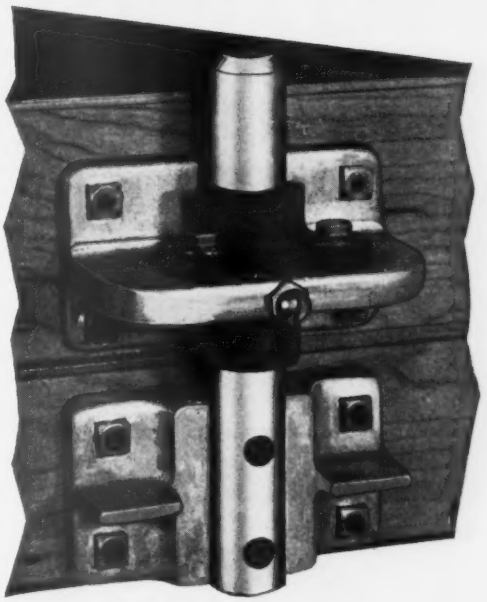
V-G ROUND PIN ASSEMBLY



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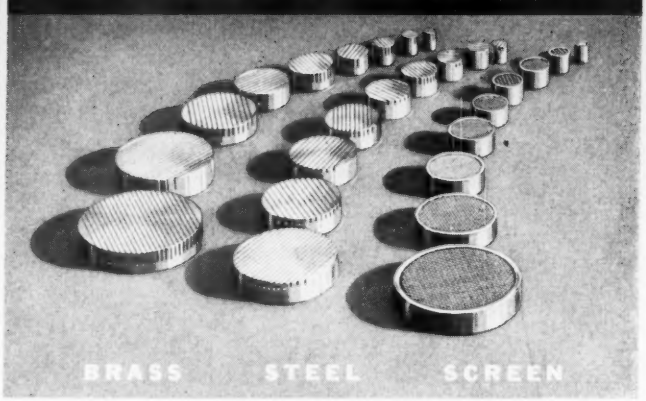

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Mesh: #30, #40, #50
Diameters: 3/16", 1/4", 5/16", 3/8", 7/16", 1/2", 5/8", 3/4", 7/8", 1", 1 1/4", 1 1/2"

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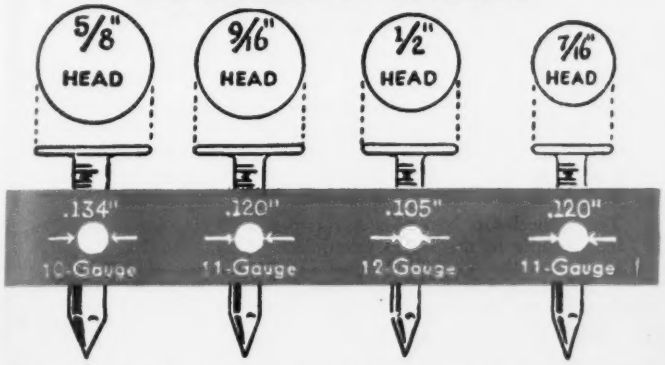

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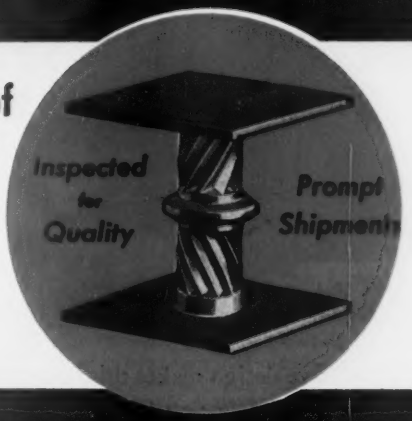
Standard Foundry Nails available in all lengths.

All styles of Chaplets Accurately Made for Better Castings



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Sands for synthetic molding . . . cores . . . furnace bottoms. . . . All grades washed, dried and screened to accurate sizes . . . Wide range of grain fineness. For use in steel, gray iron and malleable, brass, aluminum and magnesium castings. For sandblasting, foundrymen find Flint Shot or Diamond Sandblast efficient and economical because it can be used over and over again.

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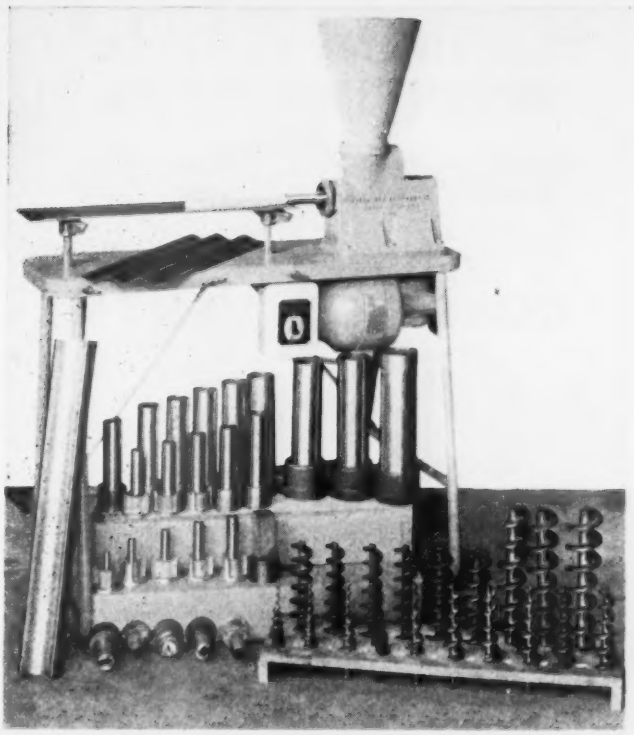

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By: WADSWORTH EQUIPMENT CO.
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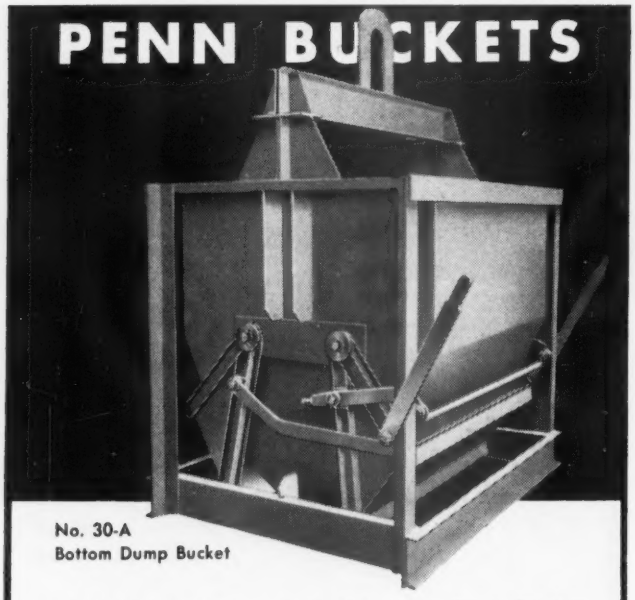

No. 30-A
Bottom Dump Bucket

Exclusive design makes this bottom dump bucket easy to operate . . . easy to open. Efficient for foundry use in handling all types of sand, moulding or core, dry or prepared. Can be used with coke, scrap iron and castings also. Sizes 7 to 200 cu. ft.

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LIGHT — MEDIUM — DARK
. . . a shade to match every iron or steel casting

Because different cast metals vary in shade and texture, Smooth-On No. 4 Foundry Cement is supplied in three shades, to match light, medium and dark gray metals. This enables you to make repairs that are almost invisible when you true up small holes, pock-marks, depressions. For light gray, finer textured metal you use Smooth-On No. 4AA, which may be filed and machined. Medium gray castings call for No. 4A. Dark gray castings of coarser texture are matched with Smooth-On No. 4B. If your supply house hasn't Smooth-On Foundry Cements, write us.

FREE Samples and Handbook

Try Smooth-On No. 4 at our expense. Write for free sample in the shade you'd like to try. We'll send also the 40-page Smooth-On Handbook describing other Smooth-On Cements and their time-and-money-saving uses. Write TODAY.

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Do it with SMOOTH-ON FOUNDRY CEMENT

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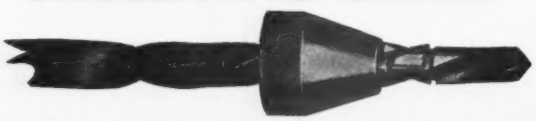
INSERTING DRILL



• Uniformity of holes • Faster insertion of vent
• Correct Depth

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DEEP HEAD
Wide or Narrow Slots
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VENT CLEANER

For Cleaning Slots
Made of Tempered Steel, Easy to Use

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TOOLS • PRECISION MACHINED and GROUND PARTS • FIXTURES

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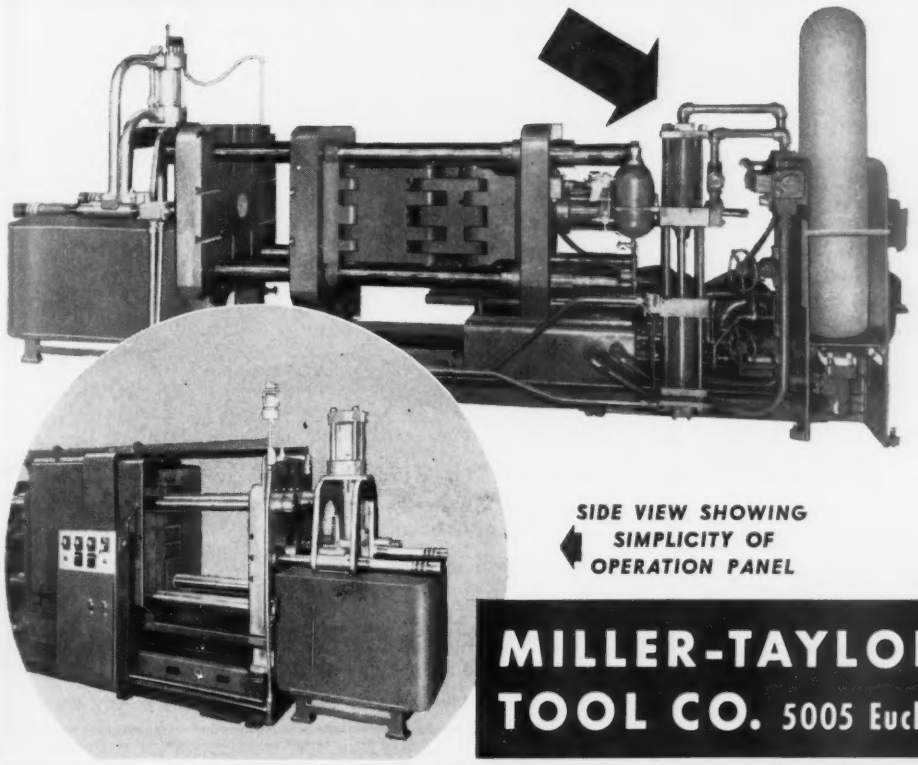
New Hydraulic System makes CAST-MASTER Safest in Industry



SIDE VIEW SHOWING SIMPLICITY OF OPERATION PANEL

. . . ELIMINATES FIRE HAZARDS!

Another Miller-Taylor achievement that makes the new CAST-MASTER die casting machines the safest in the industry. The new closed hydraulic system uses either soluble or a nonflammable oil instead of hydraulic oil to eliminate fire hazards on the shot end of the machine. Telescopic Fluid Transmission assemblies to hydraulic ejection die lock and shot cylinder eliminates all hose and flexible piping—thus offering an additional safety feature. For complete safety protection and maximum operating efficiency you'll find it hard to match the newly improved CAST-MASTER!

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There is no better time than NOW to review incentives, methods, scheduling, production control and paperwork processes.

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"HOOK-ON" SINGLE LINE

Special Type for

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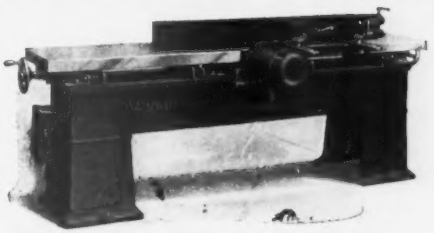
3/8 to 2 cu. yd. cap.

Send for descriptive bulletin.

THE WELLMAN ENGINEERING CO.
7019 Central Ave. Cleveland, Ohio

built by **WELLMAN**

"OLIVER" No. 166 HAND PLANER & JOINTER



Helps patternmakers do better work faster!

This machine is the favorite among patternmakers of leading metal working plants. Has ball bearing motor-on-head drive. New type fence with tilting lever and bevel indicator. Patented circular safety-type cylinder perfectly balanced. Automatic jointer guard. Long tables are heavily ribbed, smoothly ground. Bridge design of bed gives rigid support and ample foot room. Built to give years of fine service. *Ask for Bulletin 166.*

"Oliver" makes a complete line of Hand Planers and Jointers from 6-inch to 30-inch sizes.

OLIVER MACHINERY COMPANY
Established 1890 GRAND RAPIDS 2, MICH.

No. 4 DAYTON RING VALVE BENCH RAMMER

MORE POWER—MORE SPEED

You'll get more production with these faster, more powerful rammers and at the same time substantially reduce maintenance costs.

The Valve Units will last for years. The Cylinder Bores and Piston Rods are HARD CHROME PLATED which doubles the life of the Rammer. Many of the largest foundries in the country have already adopted them as standard. Made in six sizes to meet every requirement.

Send for Bulletin 300

DAYTON PNEUMATIC TOOL CO.

Manufacturers of Pneumatic Tools Since 1903

DAYTON, OHIO

HAYNES EQUIPMENT JOLT SQUEEZER

This portable jolt squeezer is furnished in two sizes: 10" squeeze cylinder with 3" jolt cylinder and 12" squeeze cylinder with 4" jolt cylinder. Jolt tables 17" x 20" and 19" x 22".

The post and squeeze cylinder are cast in one piece. Top of post machined to take 2-7/16" cold rolled shaft for the swing arm. Zerk fittings throughout.

No bolts or screws in this machine!

FULLY EQUIPPED

Equipped with air gauge, pop-off gauge and pin for gate horn.

The price will interest you!

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PURO-SEAL FLUX

for producing BETTER BRASS *and* ALUMINUM CASTINGS

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Roller Bearing throughout
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FOUNDRY CORE PRACTICE

Second Edition
By Harry W. Dietert

Devoted completely and in great detail to the production of cores. Will prove beneficial to every foundryman.

548 pages illustrated — $10.00 Postpaid

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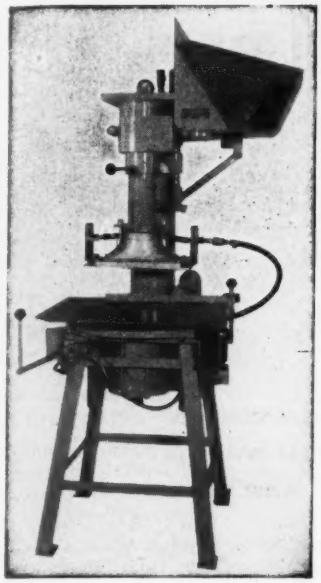


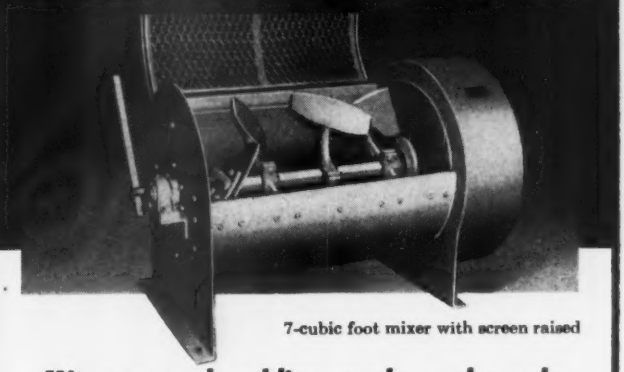
HIGH DRAW
MODEL "C-H-E"
Cores up to 8 lbs.

With the operation of one lever on the hand machine, or pushing of one button on the electric cycle, this machine will —Close the Core Box—Blow the Cores—Vibrate the Box—Draw the Cores—and Eject the Core Box to position where the dryer is applied. Produces more cores with less operator fatigue, and more cores per hour.

Let us figure on your requirements.

HARRISON MACHINE COMPANY
Wesleyville, Erie, Pa.

FASTER, BETTER MIXING
Lowers Your Operating Cost



7-cubic foot mixer with screen raised

Mix core and molding sands, and cupola patch mixes with MULTI-BLADE MIXERS

- THEY'RE FAST . . . mix and discharge a load in four and a half minutes.
- THEY MIX BETTER . . . the best blade arrangement in any mixer . . . cuts, turns and kneads the mix ten times with every shaft revolution.
- THEY'RE QUALITY BUILT . . . trouble free, self-contained, have anti-friction bearings, direct drive (no clutch or belts), and come in sizes from 3 to 60 cu. ft. capacities. Special and larger mixers also available.

Get these advantages and resultant savings. See your foundry equipment dealer or write direct to

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SAVE MONEY
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AMERICAN SHOT & GRIT

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Manufacturers' Agents!

REGISTER NOW WITH

FOUNDRY

• If you are interested in adding to the lines of foundry equipment, accessories or supplies you are now handling, please fill out the form below, or write us fully, stating what foundry equipment you are now handling and what allied lines you can take on.

We often have calls for available representation in various parts of the country and might be able to refer you to manufacturers with whom you can make a mutually profitable arrangement.

In the near future a new and revised Foundry Supply House and Manufacturers' Representative list will be published by us for use by manufacturers seeking additional sales representation and if you are in position to offer good coverage in certain areas, tell us about it and we will not only add your name to this new list but will keep the information on special file so that we may bring your facilities to the attention of those inquiring.

FILL OUT THIS FORM AND SEND IT TO US NOW

FOUNDRY,
Atten: Jack Lathrop,
Penton Building, Cleveland 13, Ohio

Date .....

Equipment or products we are now handling .....

.....

We would be interested in handling the following lines: .....

.....

Territory we now cover regularly: .....

..... Number of salesmen we employ: .....

We would appreciate being included in your new list and referring us to any manufacturers of the above equipment or producers of supplies who are seeking additional representatives.

NAME: _____

ADDRESS: _____

CITY: _____ ZONE: _____ STATE: _____

CLASSIFIED ADVERTISING

Help Wanted

METALLURGIST

A well established Detroit foundry is seeking a man experienced in good foundry practices. He must be intelligent and have sufficient mechanical knowledge and ability to take complete charge of a "Gates and Risers" program. Permanent position. Please state age, experience and other pertinent information. Our employees know of this ad.

BOX 513

FOUNDRY **6560 CASS AVE.**

DETROIT 2, MICH.

FOUNDRY SUPERINTENDENT

Experienced in all phases of the operation of a gray iron foundry (50 employes); using squeezers, jolt and rollovers. Small town, 8,000 pop., Eastern Pennsylvania.

THE DANVILLE FOUNDRY CORP.
P.O. BOX 119 **DANVILLE, PA.**

FOUNDRY FOREMAN

Production man to supervise operation of squeezers, power rollovers and bench work. Must be practical molder, experience necessary to train both new men and present operators. Must have knowledge of control on melting of metal. Brand new brass foundry in old, well established company. Address: Box 516, FOUNDRY, Cleveland 13, Ohio.

METALLURGIST

Progressive, mechanized foundry has an immediate need for an experienced metallurgist to handle complete melting operations. Attractive salary and bonus. Foundry located in Cleveland area, melts 140 tons per day. Please state age, experience and other pertinent data. Address: Box 502, FOUNDRY, Cleveland 13, Ohio.

METALLURGIST

Wanted by old established plant in Tennessee operating ferrous and nonferrous foundries graduate metallurgist with foundry experience to take charge of quality control. Must have good personality, able to handle and work with labor. Salary commensurate with education and experience. Excellent opportunity for advancement. Address: Box 510, FOUNDRY, Cleveland 13, Ohio.

MANAGER

To invest and help organize company for foundry prefab and manufacturing plant. Must be capable of managing business. Successfully operating at present. No indebtedness. Owner wishes to keep money in business. Address: Box 509, FOUNDRY, Cleveland 13, Ohio.

SALESMAN

To sell core binding synthetic resins to foundry trade in South. Choice of territory. Commission basis. Address: Box 522, FOUNDRY, Cleveland 13, Ohio.

GENERAL SUPERINTENDENT

We need a man capable of handling a modern mechanized foundry with several hundred employees. Knowledge of aluminum not essential—we have the necessary technicians. We want foundry managerial experience. This is a permanent lucrative position. Kindly state age, education and experience.

ALUMINUM ALLOYS CORP.

6650 W. WALTON **DETROIT 10, MICH.**

TYLER 8-5300

MOLDING FOREMEN

Cleaning room foreman, molding room foreman and core room foreman with grey iron foundry experience wanted for permanent position in mechanized foundry. Producing automotive castings, located in middle west. Excellent opportunity with large, reputable manufacturing concern. Write stating experience, qualifications and expected salary. Address: Box 341, FOUNDRY, Cleveland 13, Ohio.

FOUNDRY ENGINEER

Set up and supervise small aluminum foundry. Experience in permanent molds desirable. Metropolitan New York. Give age, training and experience in first letter. Address: Box 523, FOUNDRY, 60 East 42nd St., New York 17, N. Y.

GENERAL FOREMAN

For New Jersey foundry in business fifty years. Grey iron and semi steel foundry pouring 6 to 8 tons daily. 42 men. General jobbing dry and green sand. Must be practical and have cupola experience. Reply in confidence giving age, experience and salary requirements. Address: Box 488, FOUNDRY, Cleveland 13, Ohio.

FOUNDRY SUPERINTENDENT

New England foundry, employing 170 men, producing small items of air-furnace and cupola malleable iron, also nonferrous has opening for good production man experienced in all phases of foundry operations. Technical graduate with practical experience preferred. Please give age, education, experience and salary required in first letter. Address: Box 485, FOUNDRY, Cleveland 13, Ohio.

FOUNDRY SUPERINTENDENT

For shop producing 500 tons carbon and alloy steel, 300 tons electric iron and 150 tons brass pressure vessel castings per month. Must have broad and extensive experience in foundry operations, proven administrative ability, and good practical and technical background. Excellent opportunity with long established company of best reputation.
Reply in confidence giving full information as to age, background and experience as well as salary requirements. Address: Box 470, FOUNDRY, Cleveland 13, Ohio.

EXPERIENCED FOUNDRYMAN

Midwestern gray iron foundry desires experienced man capable of supervising production and assembly of small to medium sized cores. Must be able to teach and coordinate making of cores on benches and coreblowers. In replying please state age, experience and salary expected. Address: Box 302, FOUNDRY, Cleveland 13, Ohio.

ASSISTANT SUPERINTENDENT

Gray iron foundry wants competent man with experience in production of high grade castings, squeezer and rollover work. Address: Box 467, FOUNDRY, Cleveland 13, Ohio.

FOUNDRY SUPERVISOR

For a gray iron foundry in Eastern Pennsylvania melting 50 tons a day. Setup jobs; molding rates; estimate costs; read blue prints. Well-experienced in cupola practice, molding, coremaking, sand control and patterns. Address: Box 435, FOUNDRY, Cleveland 13, Ohio.

FOUNDRY SUPERINTENDENT

Good opportunity for foundry superintendent who is fully qualified to operate small grey iron and bronze foundry. Address: BOLEN MACHINE WORKS, INC., GRAND JUNCTION, COLORADO.

FOUNDRY SUPERINTENDENT

Thorough experience in nonferrous foundry required. Must have technical knowledge and experience in all phases of foundry work in a shop using automatic molding and core blowing practices and producing pressure type work with synthetic sand. Please give personal experience, history, availability and salary expected in first letter. Address: Box 517, FOUNDRY, Cleveland 13, Ohio.

FOUNDRY SUPERINTENDENT WANTED FOR CONNECTICUT CAST IRON FOUNDRY

Responsible position for a man with initiative and experience in all phases of cast iron and malleable iron production. Address: Box 526, FOUNDRY, Cleveland 13, Ohio.

SUPERVISOR STEEL

Supervisor for large Michigan Foundry. Must be an experienced foundryman in production of steel automotive castings. Give complete history and salary expected. All replies confidential.

BOX 525

FOUNDRY **CLEVELAND 13, OHIO**

CORE ROOM FOREMAN

Medium sized, highly mechanized gray iron foundry in New York State has openings for core room foreman, foundry foreman and master mechanic. Must be aggressive, with extensive experience. State age, experience, qualifications and expected salary. Address: Box 518, FOUNDRY, Cleveland 13, Ohio.

WANTED

Sand technician and control man—gray iron foundry Middlewest. Address: Box 475, FOUNDRY, Cleveland 13, Ohio.

DIE CAST DIE DESIGNER OR PERMANENT MOLD DESIGNER

Die cast die designer or permanent mold designer. Light metals experience required. This is a permanent job with unlimited future for qualified man. Position is in modern midwest foundry facility now undergoing expansion. Salary commensurate with ability. Bonus plan. Send complete resume. Address: Box 499, FOUNDRY, Cleveland 13, Ohio.

JOLT-STRIP FOREMAN

Foreman to set up and supervise mechanized rollover and jolt squeeze strip production line. Must be experienced on this type unit producing high production. This is a new production line in the East. State age and experience. Address: Box 500, FOUNDRY, Cleveland 13, Ohio.

PATTERN MAKERS

Good future for experienced pattern makers in largest steel foundry in intermountain West. State qualifications, age and availability. Address: Box 413, FOUNDRY, Cleveland 13, Ohio.

EXPERIENCED CORE ROOM FOREMAN

Well versed in medium and heavy machine tool castings. Location, Michigan. In replying please state age, experience and salary expected. Address: Box 503, FOUNDRY, Cleveland 13, Ohio.

Positions Wanted

GENERAL MANAGER

Invites confidential correspondence with owner of established and medium-size business requiring mature, dependable directing experience in management, sales, finance and production. Ability to carry complete responsibility and produce consistent sales and production costs and net results assured by previous record. Excellent experience iron and brass foundries, machine and related lines. Address: Box 134, FOUNDRY, Cleveland 13, Ohio.

PRACTICAL-TECHNICAL

Gray iron foundryman of proven ability and experience, age 49 seeks new connection. Experience covers jobbing, mechanized foundries from molder to superintendent. Capable and qualified through experience to direct all phases of foundry activities. Well versed in rigging, metallurgy, blueprints, producing quality at a minimum. Address: Box 515, FOUNDRY, Cleveland 13, Ohio.

FOUNDRY MANAGER OR SUPERINTENDENT

Age 41, associated with well known machine tool foundries for 24 years. Gray iron, light, medium or heavy. Qualified to develop your organization for a greater degree of quality, morale and successful operation. Address: Box 466, FOUNDRY, Cleveland 13, Ohio.

Positions Wanted

METALLURGIST—ELECTRIC MELTER

Years of experience in actual working and supervisory capacity in above positions. Production, carbon, alloy and manganese steel—acid and basic practice. Sand control, laboratory, heat treat, technical and practical operations. Seeking responsible position with good company. Dependable and reliable. Address: Box 495, FOUNDRY, Cleveland 13, Ohio.

ASSISTANT OR SUPERINTENDENT

Practical gray iron foundryman technically trained with broad background of 28 years' experience in general jobbing and high production. Machine tool, high pressure pumps, automotive, farm implements. Well versed and sound in all departments. Desires connection with sound reliable progressive firm. Address: Box 514, FOUNDRY, Cleveland 13, Ohio.

FOUNDRY SUPERINTENDENT AND METALLURGIST

Experienced in production of quality castings, all phases of grey iron foundry operations. Know cupola operations, alloying and metallurgy, loam, green and dry sand practice. Castings weighing ½ to 25,000 lbs. Production 1,700,000 lbs. of good castings per month. Casting loss very low 0.65 to 0.75 or less per month. Come and see for yourself. Also experience in brass, bronze and aluminum castings. Married, age 45. Address: Box 512, FOUNDRY, Cleveland 13, Ohio.

PLANT MANAGER OR SUPERINTENDENT

For gray iron and semi steel. Molding experience eighteen years, foreman two years, superintendent eleven years, manager nine years small foundry. Specialized in price work, figure jobs from blue prints to supervising cupola or electric furnace. Have run large and small shops, jobbing and production work. Employed now. Would like to change. Age 58, good references, good health. Address: Box 493, FOUNDRY, Cleveland 13, Ohio.

COREROOM SUPERINTENDENT

Jobbing or production coreroom. Well versed on coreblowers, rollover machines, bench, floor, assembly, sand mixing, core drying and all types of coreroom equipment. Better cores at reduced costs and increased production. Young, reliable, hard worker and good labor relations. Address: Box 519, FOUNDRY, Cleveland 13, Ohio.

SALES POSITION

Young man, 26, currently selling to foundry trade. College graduate, single, free to travel and relocate desires sales position in foundry or allied industry. Address: Box 501, FOUNDRY, Cleveland 13, Ohio.

TECHNICAL FOUNDRY SUPERINTENDENT

Practical, progressive experience of 20 years as journeyman and executive supervision in grey iron and nonferrous sand castings. Job and production rigging of automotive and medium heavy machinery types in green, dry and loam sands. Engineering education, outstanding labor relations, high productivity and low scrap ratio records. Experience includes sales engineering and extensive knowledge of machine shop operations. Age 44, desires permanent connection in the eastern states. Address: Box 430, FOUNDRY, Cleveland 13, Ohio.

FOUNDRYMAN

Practical and technical foundryman of both iron and steel, well versed with over 20 years' experience in all phases of foundry practice. Worked from molder and coremaker to superintendent and manager with excellent record. Aggressive and good personality, employed. Available on reasonable notice. Address: Box 486, FOUNDRY, Cleveland 13, Ohio.

CHIEF ACCOUNTANT—OFFICE MANAGER

Thoroughly experienced in foundry operations desires affiliation with manufacturer engaged in defense production. Excellent cost accountant and tax expert. Familiar with N.P.A. and O.P.S. regulations. Heavy experience in all phases of export. College graduate, age 32, married, no children. Available August 1. Prefer north-eastern location. Address: Box 487, FOUNDRY, Cleveland 13, Ohio.

GENERAL MANAGER OR SUPERINTENDENT

Twenty years' experience in all phases of foundry operations and supervision. Desires permanent position with a progressive company, producing quality grey iron, semi-steel or steel castings, jobbing or production. Available on reasonable notice. At present employed. Address: Box 419, FOUNDRY, Cleveland 13, Ohio.

SALES REPRESENTATIVE

Practical foundryman with academic training, 26 years' operative experience in ferrous foundries seeks affiliation with foundry supply firm as technical or sales representative. Address: Box 491, FOUNDRY, Cleveland 13, Ohio.

FOUNDRY FOREMAN OR SUPERINTENDENT

22 years' experience in malleable and gray iron. Know all phases of foundry operations, molding, air furnace, cupola and sand. Address: Box 484, FOUNDRY, Cleveland 13, Ohio.

MANAGER OR SUPERINTENDENT

Twenty-eight years of foundry experience in grey iron production and jobbing work. Ten years of practical and technical training with eighteen years in executive capacity. Experience in semi or mechanized shops. Age 46, best of references. Address: Box 357, FOUNDRY, Cleveland 13, Ohio.

FOREMAN METAL PATTERN MAKER

Successful background designing, supervising and constructing modern pattern equipment and core boxes to insure maximum production and minimum casting costs. Plumbing goods and large production runs a specialty. Can guarantee results. Address: Box 481, FOUNDRY, Cleveland 13, Ohio.

MANAGER—ASSISTANT TO PRESIDENT

Steel, iron, brass. Thoroughly experienced in every shop operation, metallurgy, engineering, accounting and management. Excellent ability to develop a superior organization by leading, teaching and example. Outstanding reputation for keen analysis, sound judgment and a rare combination of practical experience, managerial ability and effective personality. Address: Box 375, FOUNDRY, Cleveland 13, Ohio.

GREY IRON FOUNDRYMAN

Available. Capable, qualified and experienced to direct all phases of foundry activities. Light to medium heavy work. Green and dry sand. Well versed in cupola operation and metallurgy. 15 years in present executive position. Middle age. Pleasing personality. Address: Box 460, FOUNDRY, Cleveland 13, Ohio.

METALLURGICAL ENGINEER

Twenty-seven years' operative experience in grey iron, malleable iron and brass foundries, production and jobbing work, cupola electric furnace and duplex melting, progressive sand control for molding and core making, heat treating and gating, cost conscious seeks employment with progressive foundry. Address: Box 492, FOUNDRY, Cleveland 13, Ohio.

SUPERINTENDENT—MANAGER

Fifteen years' experience in all phases of foundry operation, supervison including operation of own plant. Desire permanent position with progressive company producing quality gray iron or semi-steel castings, jobbing or production. Address: Box 511, FOUNDRY, Cleveland 13, Ohio.

METALLURGICAL ENGINEER

Sixteen years' experience in iron, steel and special alloys foundries. Comprehensive experience in iron and steel castings; open hearth, air, electric and induction furnace metallurgy. Qualified to superintend foundry, head research department, technically assist executive, technical sales, head metallurgy. Address: Box 497, FOUNDRY, Cleveland 13, Ohio.

METALLURGICAL ENGINEER

Age 41, B.Sc., experience includes plastics research; aluminum and brass foundry; brass mill; pure iron production. Able to initiate and control metallurgical problems. Midwest, especially St. Louis, preferred. Address: Box 496, FOUNDRY, Cleveland 13, Ohio.

GOVERNMENT CONTACT MAN

Twenty years steel mill and steel sales experience. Ten years government experience. Presently employed in Washington National Production Authority. Washington office available. Address: Box 524, FOUNDRY, Cleveland 13, Ohio.

GRAY IRON METALLURGIST

Twenty years' experience. Physical, chemical microscopic work. Cupola operation. Sixty years old. Address: Box 508, FOUNDRY, Cleveland 13, Ohio.

WEIGHT ESTIMATING

Estimating of casting weights furnished by return mail. Accurate, reliable and confidential service. Nominal fee. Send blueprints. Address: CHARLES E. ROLAND, 215 FOREST DRIVE, Itasca, Ill.

CLASSIFIED ADVERTISING

Trade

Swing frame snagging and grinding unit mounted on 16 ball bearings, movable compound frame. Frame area 10 feet long, 5 feet wide and 5 feet high. Frame and grinder cost approximately $2,000; used two months. Excellent for aluminum, bronze and iron castings, flat or irregular castings. Machine completely motorized and vibration-proof. Will trade this beautiful unit for aluminum castings—we have patterns.

CHALFIN MACHINE PRODUCTS CORP.
6202 SIXTH AVENUE
BROOKLYN 20, N. Y.

Employment Service

SALARIED PERSONNEL

$3,000-$25,000. This reliable service, established 1927, conducts confidential negotiations for high grade men who seek a change of connection under conditions assuring if employed full protection to present position. Send name and address only for details. Personal consultation invited. Address: JIRA THAYER JENNINGS, 241 ORANGE STREET, NEW HAVEN 10, CONN.

SALARIED POSITIONS

$3,500 to $35,000. We offer the original personal employment service (established 41 years). Procedure of highest ethical standards is individualized to your personal requirements. Identity covered; present position protected. Ask for particulars. Address: R. W. BIXBY, INC., 101 DUN BUILDING, BUFFALO 2, NEW YORK.

Engineering Service

ENGINEERS AVAILABLE

To design and build Pressure Casting Equipment for your own plant and train your men. To produce all types of pressure castings including aluminum matchplates, cope and drag plates, core boxes and all nonferrous precision castings in plaster molds. Twenty-three years' experience.

BOX 506
FOUNDRY CLEVELAND 13, OHIO

Foundry Consultant

FOUNDRY CONSULTANT

Available for short periods. We specialize in scrap castings—how to eliminate or why we have scrap. Have 35 years' experience as molder, core maker and executive. Address: Box 521, FOUNDRY, Cleveland 13, Ohio.

Capacity Wanted

OPEN CAPACITY

We are seeking a dependable Gray Iron Foundry in the middle west, capable and equipped to produce heavy machinery castings. Please give details of equipment and maximum weight castings made. Address: Box 446, FOUNDRY, Cleveland 13, Ohio.

Opportunity

SALES OPPORTUNITY

HERE'S AN EXCELLENT OPPORTUNITY FOR A MAN WELL EXPERIENCED IN FOUNDRY WORK, AND PARTICULARLY IN CORE ROOM OPERATIONS, TO SELL A NATIONALLY KNOWN LINE OF QUALITY CORE OILS FOR A AAA1 COMPANY.

HARD-WORKING, SOBER, PERSISTENT, HIGH TYPE OF MAN REQUIRED, WHO IS ABLE TO MEET ALL LEVELS OF FOUNDRY MANAGEMENT AND OPERATION WITH EQUAL EASE, DEMONSTRATE HIS FOUNDRY KNOWLEDGE AND INSPIRE THE CUSTOMER'S CONFIDENCE IN HIS ABILITY TO RECOMMEND THE PROPER CORE MIXES AND OFFER SOUND TECHNICAL ASSISTANCE ON MANY PHASES OF CORE ROOM PROBLEMS.

A UNIQUE OPPORTUNITY FOR A FOUNDRY SUPERINTENDENT OR CORE ROOM FOREMAN WHO HAS ALWAYS WANTED TO SELL AND WHO FEELS HE CAN PERFORM A VALUABLE SERVICE TO HIS CUSTOMERS BY GIVING THEM THE BENEFIT OF HIS LIFE'S EXPERIENCE AND "KNOW-HOW" IN HELPING SOLVE THEIR CORE PROBLEMS AND IMPROVE THEIR CORE PRODUCTION. PREVIOUS SELLING EXPERIENCE NOT AS IMPORTANT AS THE ABILITY TO TALK THE FOUNDRYMAN'S LANGUAGE AND OFFER REAL TECHNICAL ASSISTANCE. SHOULD HAVE PLEASING PERSONALITY, ENJOY TRAVELING AND TALKING FOUNDRY PROBLEMS, AND BE ABLE TO MANAGE HIS OWN TIME AND ENERGIES EFFICIENTLY TO BRING RESULTS.

SEVERAL EXCELLENT TERRITORIES ARE NOW OPEN ON A SALARY AND COMMISSION BASIS. AGE 40 TO 60 YEARS. WRITE BOX 498 ENCLOSING A RECENT PHOTOGRAPH, AND GIVING DETAILS OF YOUR QUALIFICATIONS, BACKGROUND, AND EXPERIENCE IN FULL. ALL REPLIES WILL BE KEPT CONFIDENTIAL.

BOX 498

FOUNDRY **CLEVELAND 13, OHIO**

PRESSURE CASTING

Foundryman or patternman to operate small pressure casting plant in good industrial location. Small investment required.

BOX 507

FOUNDRY **CLEVELAND 13, OHIO**

Foundries For Sale

FOUNDRY FOR SALE

Most profitable medium size jobbing foundry in this section of the country. Well equipped, situated between Cleveland and Detroit. Arranged for production. Deal involves $250,000.00. Owners must retire. Opportunity for user of castings with certificate of necessity. Address: Box 340, FOUNDRY, Cleveland 13, Ohio.

FOUNDRIES FOR SALE

IRON FOUNDRY. Equipped with new machines for production of light castings. Very profitable business.

IRON FOUNDRY. Well equipped to produce castings up to 20 tons. Good organization.

ALUMINUM FOUNDRY. New building and equipment. A bargain.

EDWARD H. ZOLL

INDUSTRIAL PROPERTIES THROUGHOUT THE EAST

790 BROAD ST. **NEWARK 2, N. J.**

Foundries For Sale

GRAY-IRON FOUNDRY

Brick and steel foundry with two clear spaces 80 x 320 ft. with overhead monorail, story height 13 ft. 6 in., gable 23 ft., attached building 40 x 50 ft., story heights 15 ft. 6 in. and 13 ft. 4 in., has two No. 7 Whiting cupolas 72 in. in diameter. Contains equipment, ideal for mechanized operation, plenty dumping ground, built 1917, composition roof, vicinity population about 9000, near center of U. S. population, expect natural gas this year, served by two major railroads, water transportation available, city hydrant fire protection, land for expansion. Subject to withdrawal without notice. Address: Box 358, FOUNDRY, Cleveland 13, Ohio.

GRAY IRON FOUNDRY

Plant 25,000 sq. ft. plus 150,000 sq. ft. vacant land, completely mechanized overhead sand system. At present set up to produce 1,200 lengths 4" extra heavy soil pipe in 8 hour shift. Could be converted to magnesium or aluminum mass production. Will sell plant and equipment together or separately or will lease to responsible party. Reasonable terms arranged. Address: Allied Foundry Co. Inc., 2 Pacific Ave., Jersey City, N. J.

SMALL FOUNDRY FOR SALE

On New York Central Railroad side track in Lockport, New York. Floor space of molders approximately 11,000 square feet with exceptional dumping ground for disposal of slag and waste indefinitely at lowest expense over declivity on the land. Considerable foundry equipment thrown in for the price of assessed value of the real estate. Address: JEFFERSON UNION COMPANY, LOCKPORT, NEW YORK.

FOR SALE

Nonferrous foundry in large Wisconsin industrial town. Get in at the start. We have a large volume of defense orders. Owners must retire. Price $50,000. Address: Box 504, FOUNDRY, Cleveland 13, Ohio.

Available Capacity

OPEN CAPACITY

Have limited open capacity for high quality gray iron castings for jolt-squeeze or floor work. ADDRESS: O. K. FOUNDRY CO., 1005 E. 9TH STREET ROAD, RICHMOND, VIRGINIA.

OPEN CAPACITY

Production runs, small to medium size grey iron castings. Send samples to: BUCK IRON COMPANY, ROUTE #1, QUARRYVILLE, PA.

AVAILABLE CAPACITY

Our foundry has open capacity to supply small and medium size gray iron castings. Send sample. Address: OREGON CASTINGS CO., RD 3, Lititz, Pa.

OPEN CAPACITY

Brass or bronze centrifugally cast bushings. Can meet all specifications including x-ray. Address: FOUNDRY DIVISION, CENTRIFUGAL CASTING MACHINE CO., P. O. BOX 947, TULSA, OKLAHOMA.

Wanted-To-Buy

MIXERS WANTED

Used Simpson Intensive Sand Mixers. State size, condition and lowest cash price or immediate acceptance. Address Box 578, FOUNDRY, Cleveland 13, Ohio.

WANTED

Millett type portable core oven with four 7" and one 11" semi circular or quarter round shelves equipped with natural gas burners. Address: SMITH & RICHARDSON MFG. CO., GENEVA, ILL.

WANTED

USED EQUIPMENT

Tabor Plain Squeeze Molding Machine
Jolt Squeeze Molding Machine
Hausfeld Oil Fired Stationary Furnace—No. 80-100-175
Turbo Blower 3 H.P. for two furnaces
Pangborn G.J. 1 or G.J. 2 Rotoblast Barrel
Five Drawer Core Oven with Burners
Screenarator
36" Band Saw complete with motor
Heavy Duty Grinder with guards, motors, wheels
Wheelabrator 20 x 27 complete
Heavy duty roller conveyors—12 inch.
Platform Scale
Small Lift Truck.
Advise age, condition, and price delivered to New Jersey.

HALL FOUNDRIES, INC.
100 WEST 52nd STREET
NEW YORK 19, N. Y.

WANTED

Used mulling machine and used stationary sand slinger. Must be in good condition. State price in first letter. Address: GRUBBS FOUNDRY, 4700 Rosa St., El Paso, Texas.

WANTED TO BUY

TABOR SQUEEZE STRIPPING MOLDING MACHINE. STATE AGE, CONDITION AND PRICE

NATIONAL FOUNDRY CO. OF NEW YORK INC.
10 SANDFORD STREET
BROOKLYN 5, NEW YORK

WANTED

BRIDGE CRANES

ARNOLD HUGHES COMPANY
765 PENOBSCOT BLDG. DETROIT 26, MICH.
WOODWARD 1-1894

WANTED

One gas fired core oven with controls, either drawer type or push in type. Desirable inside dimensions 5 to 6 feet wide, 6 feet high, 6 to 7 feet deep. State make, condition and price in first reply. Address: Box 448, FOUNDRY, Cleveland 13, Ohio.

Wanted-To-Buy

WANTED

1—Air jarring molding machine 20" cylinder-table 66" x 84", 14,000 lbs. capacity (Similar to International Molding Machine Co.'s type J.) State make, age, conditions and price.

PAXTON-MITCHELL CO.
2614 MARTHA ST. OMAHA, NEBRASKA

WANTED

TWO GAS OR OIL MELTING FURNACES, 50 CRUCIBLE, STATE PRICE AND CONDITION OF EQUIPMENT IN FIRST LETTER.

SCHILLING BRONZE CO.
ROME, NEW YORK

WANTED

PRACTICALLY NEW STANDARD TRACTOR SANDSLINGER.

BOX 520
FOUNDRY CLEVELAND 13, OHIO

WANTED

Sand Blast & Foundry Equipment & Parts.
Address: DIAMOND SALES, INC.
5654 WEST JEFF., DETROIT 9, MICH.

For Sale

FOR SALE

1—#404 Clearfield sand muller, automatic discharge, direct drive, 5 H.P. motor, 3 phase, 60 cycle, 220 volt. Address: ATLAS FOUNDRY Co., Marion, Indiana.

FOR SALE

1—Simpson sand mill—size 1½, model S, Style E, Serial #22173—one lot spare parts. Address: MICHIGAN STEEL CASTING CO., FOOT OF ST. AUBIN AVE., DETROIT 7, MICHIGAN.

FOR SALE

Select scrap graphite electrodes for recarburizing and carbon pick up in cupola electric furnaces and open hearth. Address: Box 494, FOUNDRY, Cleveland 13, Ohio.

FOR SALE

2—Osborn #332-38 Jolt Squeeze Rollover Draw
3—Osborn #601 Jolt Rollover Pattern Draw Machines
2—Osborn #712 Jolt Squeeze Pin Lift Machines Never Used.
2—Tabor Portable Jolt Rollover Pattern Draw Machines 30 x 40 Tables
2—International Jolt Rollover Pattern Draw Molding Machines—Portable Type
2—International Type F, 27 x 16 Heavy Duty Jolt Rollover Pattern Draw Molding Machines in service 18 months.
6—Hand Rollover Core Machines, 20 x 8, 22 x 12, 18 x 8.
1—American late model gasoline power driven sand cutter. Like new.
1—Jeffrey sand conditioner. Excellent condition. All equipment immediately available.

BOX 439
FOUNDRY CLEVELAND 13, OHIO

FOR SALE

TURBO BLOWERS (3 Phase, 60 Cycle)

cfm	Pressure	Make	Motor H.P.	Volts	Speed
3500	40 oz.	Spencer	60	440	1800
1000	32 oz.	Spencer	15	220	
225	10 oz.	Spencer	1	220/440	3600

PRESSURE BLOWERS (3 Phase, 60 Cycle)
8150/62500 Bishop & Babcock (40½x50 outlet)

2500	7 oz.	Sturtevant	15	220/440	1800
2400	14 oz.	Mahr	15	220/440	3480
2300	1" SP	Clarage	3	220/440	1800
1800	1 in.	Sturtevant	2	220/440	
800	8 oz.	Nth.Amer.	3	220	3600
660	20 oz.	AllenBillmyre	7½	440	3600
450	6 lb.	A&B	30	220/440	3450
400	4.3 oz.	Spencer	2	220/3/60	3500
340	20 oz.	AllenBillmyre	3	440	3600
150	12 oz.	Nth.Amer.	1	220	3600

MOTOR REPAIR & MFG. CO.
1552 HAMILTON AVENUE
CLEVELAND, OHIO

For Sale

FOR SALE

1—No. 167-2 Milwaukee jolt, squeeze rollover draw molding machine. Taking maximum flask 32" x 32"—12" draw—16" sq. cylinder. Purchased new 1944 used approximately 17 months. Machine in good operating condition. ADDRESS: G. H. R. FOUNDRY, DAYTON 1, OHIO.

FOR SALE

4—Coke Pit Type, No. 60 Crucible Furnaces. 3—forced draft, hinged covers.
1—Royer Sand Separator & Blender. Model "NB—4" 110 V. 1 ph. 60 Cy.—good condition.
1—9" x 8" Sullivan horizontal Air Compressor. Class "WG—6" 176 CFM 15 h.p. 550 volts —"V"-belt drive on welded steel base as complete unit. In excellent condition.
1—Pangborn Sandblast Cabinet, handholes, treadle valve. E N 2—No. 53, serial 51422914. 36" x 36" x 58".
2—Steel flasks—Black, Sivalls & Bryson Inc.—style SP 22 57" x 63", 6" Cope—4" drag. Double pin lug—loose pins—clamp lugs—trunnions and lifting bail, used very little.
1 Set—No. 100 Crucible tongs, & shank—new.

J. H. TAYLOR FOUNDRY INC.
QUINCY 71, MASS.

SANDCUTTERS FOR SALE WITH SPARE PARTS

American type CP 5 foot cutter. Serial CP156. Price $700.00.
American type CP 6 foot cutter. Serial 129-R. Price $1300.00.

LEHIGH FOUNDRIES, INC.
EASTON, PA.

PRESSURE CASTING EQUIPMENT FOR SALE —REASONABLE

Small complete unit of Pressure Casting Equipment capable of producing all types of aluminum pattern equipment and precision castings. Cash or terms.

BOX 505
FOUNDRY CLEVELAND 13, OHIO

FOR SALE
BLOWERS

2—Roots Connersville, size 10½, rated at 7300 cfm @ 7½# pressure
2—Roots Connersville, size 6, rated at 6500 cfm @ 1½# pressure
2—4 ton Bottom blow Bessemer convertors (can be changed to 6-ton blow)

ARNOLD HUGHES COMPANY
765 PENOBSCOT BLDG., DETROIT 26, MICH.
WOODWARD 1-1894

FOR SALE

1—Stroman twin burner, oil fired melting furnace. 600# capacity. Price $850.00.
1—40# Detroit rocking furnace, used approximately 30 heats. Complete $1800.00.

BUCK IRON CO.
ROUTE #1 QUARRYVILLE, PA.

FLASKS AND JACKETS

2—sets slightly used 24" x 28" Hines pop-off flasks 6" cope, 6" drag.
2—sets, as above, except 8" cope, 8" drag, also slightly used. $200.00 per set.
12—10" aluminum jackets. $20.00 ea.
—For above can furnish 2—24" x 28" bolster plates complete with pins and bushings.
1—20" x 20" Hines pop-off flask 6" cope, 8" drag. Never used. $115.00.

THE J. B. EHRSAM & SONS MFG. CO.
ENTERPRISE, KANSAS

FOR SALE

Two large Herman rollover & Jarring machines. 6000 and 3000 lb. capacity—immediate delivery.

AAA SALVAGE COMPANY
3047 WOODLAND AVENUE
CLEVELAND, OHIO

TELEPHONES: SUPERIOR 1-6133

FOR SALE

Cupola charger complete—including weigh hopper, transfer car and 60" cone bottom bucket. Also #8 Whiting cupola, 9000 C.F.M. Roots positive blower.

AUBURN FOUNDRY, INC.
AUBURN, INDIANA

CLASSIFIED ADVERTISING

SAND BLASTING EQUIPMENT FOR SALE

American Wheelabrator cabinet, 3 wheels 10" with motors and controls. Designed for shot peening engine master rods and conduit pipes.
Pangborn 6' direct pressure table with four Norbide nozzles 4AQ abrasive generator, 7BV abrasive separator, elevator conveyor — price $1000.
Ruemelin suction cabinet 72" x 36" type "AG with turntable—price $325
Pangborn suction cabinet 36" x 72" type "EN2 —price $225
Pangborn suction cabinet 36" x 48"—price $200
Pangborn, Ruemelin, American, Sly dust collectors 700-2800 CFM
Wheelabrators, rotoblast and sand blasting parts in stock.

M. ELSTEIN
141 MANGIN ST. NEW YORK 2, N. Y.

FOR SALE

We offer subject to prior sale the following heavy duty matched cast steel flasks with trunnions, condition like new:—

29 sets	19½ x 23½— 9"	cope, 4½"	drag
30 sets	19½ x 30½—10"	cope, 5"	drag
9 sets	41 x 56 — 8"	cope, 8"	drag
12 sets	38½ x 46½—11½"	cope, 5"	drag
13 sets	38½ x 39½—10"	cope, 5"	drag
2 sets	40 x 55½— 8"	cope, 8"	drag

Price .08 lb. F.O.B. grounds, Emmaus, Penna.

FOUNDRY DIVISION
GENERAL MACHINE CO., INC.
EMMAUS, PA.

FOR SALE

#3 Simpson mixer 8 ft. diameter with unit drive and skip hoist. Good condition. Price $4000.00 FOB present location. Midwest foundry. Address: Box 490, FOUNDRY, Cleveland 13, Ohio.

FOR SALE

Complete Oliver Patternmakers lathe and set machine—number 22-AC. Priced $4,800. Address: GRAHAM PIPE AND SUPPLY CO., 409 BEWLEY BLDG., FORT WORTH, TEXAS. PHONE FAnnin 1620.

FOR SALE

#1 Simpson bucket loader, 500 lb. sand capacity with legs extended 12 ft, suitable for refuse handling or loading core blower hopper. Address: VICTORIA METAL CO. INC., 2001 HAYBARGER AVE., ERIE, PA.

FOR SALE

Quantity used 12" x 18" two pin sterling steel flasks with variable copes and drags in good condition. Attractive prices. Address: NOLTE BRASS FOUNDRY CO., SPRINGFIELD, OHIO.

FOR SALE

6—"G" Rollover Machines 20 x 8.
1—SPO Jolt Strip Squeeze Molding Machine.
2—Osborn J-75 Jolt Squeezers 10".
1—Sprue Cutter with 2 HP. Motor.
1—North American Blower with 15 HP. Motor 2100 C.F.M., 16 oz pressure.
6—10" New—Haynes Jolt Squeezers.
6—12" New—Haynes Jolt Squeezers.
1—Chicago Pneumatic Air Hoist.
1—Osborn Molding Machine Model 342.
1—International Molding Machine HJ 16 x 6.
1—International Rollover Type R.
1—Band Saw.
1—#400 Stroman Tilting Type Furnace, practically new, Complete with motor, blower, and burner, and new Crucible.
1—Hausefeld Tilting Type Furnace 250 to 300 lb. capacity, practically new.
1—#36 Osborn Core Draw Machine.
1—Lyon-Raymond Hyd. Lift Truck 2500 lb. capacity.
24—Adjustable Flask Clamps.
5—New, 1⅝" Osborn Vibrators.
300 Ft. of Good Used ¾" Air Hose in 30 to 75 ft. lengths.
10—New, Squeeze Valves and Handles and 10—New Jolt Knee Valves for Milwaukee Jolt Squeezers.
1—New, Eleanor Pyrometer, up to 1600°.
3—Adams Squeezers.
2—1000 lb. Worm Gear Covered Ladles.
1—24 x 48 Tumbling Barrel.
1—#92 Osborn core blower
1—#55 Demmler core blower
1—#610 Johnston & Jennings rollover machine

HAYNES FOUNDRY EQUIPMENT CO.
814 ADA STREET KALAMAZOO 52, MICH.

For Sale

FOR SALE

1 American Sand Cutter, Type AA Size 6'-0" NW with 15 HP Motor, Volts 440, 3 Phase.

1—Style 900 GT Hausfeld Gear Tilting Cast Iron Pot for aluminum, blower driven by electric motor for use with natural gas. Brand new, has never been used.

We have the following flask equipment we will sell only as a lot, no single pieces: Hines aluminum heavy-duty pop-off type flasks, truss rods on side pieces, single pins, ¾" round. No jackets.

			Pin	
No.	Size	Cope	Drag	Centers	Condition
1	24x48	12	12	50½	Excellent, slightly used
1	34x47	12	12	51½	New
1	36x36	12	12	40	New
1	42x42	12	12	46	New
2	12x24	6	6		Excellent
1	12x24	9			Excellent
2	12x24		9		Excellent
1	16x16	6			Excellent
1	16x16		5		Excellent
1	16x24		9		Excellent
1	16x28		9		Excellent
1	18x24	6	6		Excellent
2	18x24	9			Excellent
2	20x20	9	9		Excellent
1	20x20	12	12		Excellent

MEMPHIS CASTING WORKS INC.
1006 OAKLAND AVE. MEMPHIS 1, TENN.

FOR SALE

Slightly used 1 cu. yd. Blaw-Knox size #310-WS shark tooth single line hook-on type clamshell bucket. Dual purpose to handle both coke and sand. Bargain. Address: W. P. FAVORITE CO., 6601 EAST SEVEN MILE ROAD, DETROIT 34, MICH.

LOOK
FOR SALE

Largest size Baker-Perkins continuous molding sand mixer. Model 5A equipped with Palmer Bee herringbone gear reducer attached to 75 H.P. 440 volt motor, together with electric starter, main switch, etc. Suitable for slurry or dry sand mixing. Rated capacity over 100 tons per hour. Used for experimental work two years. Excellent condition. Priced to sell at $6,500. Current price $21,000. Address: Box 489, FOUNDRY, Cleveland 13, Ohio.

FOR SALE

SAND BLAST EQUIPMENT

Pangborn 21GK2 Rotoblast bbl. over $600 in spare parts—$3500.

Pangborn Rotoblast cabinet, type ES-213. Used for cleaning propeller blades. Price 30% of list.

Pangborn 1 GF-Tum-bbl. Good condition. Price $400.00.

Pangborn direct pressure tank, model AQI, like new $575.00.

Wheelabrator 6' air table $1500.00.

Pangborn Tumble Blast Barrels, Models 1GF Cap. 1 Cu. Ft; 2-GF 2½ Cu. Ft. Cap. Air type. Like new! Priced 50% of list.

Pangborn 9 LF, 9' plain Table, wheel type, used 1 year. Like new! Complete priced 50% of list.

Sand Blast Cabinets, generators, dust collectors and blowers. All kinds and sizes. Like new. 60% less list price.

Crane—2-ton, twin hook—21' span.....$400.00

Fork lift truck—1-ton $900.00.

DIAMOND SALES INC.
5654 W. JEFF. AVE.
DETROIT 9, MICHIGAN

FOR SALE

7—275 JW Portable or Stationary Jolt Squeeze Molding Machines.
10—Walker York & Monarch Coke Fired Melting Furnaces.
30—Tabor Yoke Bar Plain Squeeze Molding Machines.
2—New Haven Sand Blast Barrels 36" x 44".
1—Pangborn 40" Revolving Table Sand Blast.
2—Screenarators—2 Royers
2—Sklenar Furnaces, 600# & 2000# capacity.
4—2047 Osborn jolt rollovers.
Tilting Ladles, 1 Ton—10 Tons.
Roller Conveyor all sizes.
We carry large stocks of all kinds of Foundry Equipment. Send us your inquiries.

UNIVERSAL MACHINERY & EQUIPMENT CO.
320 EAST BROAD ST.
SHILLINGTON, READING, PA.

FOR SALE

1 Ajax tilting induction metal melting furnace, 650 pounds aluminum capacity, 60 KW, 100 KVA, complete with extra shell, electric hoist, transformer, lining material and insulating bricks, set of templates and molds for ramming, mounted static capacitors, panel board with ammeter, voltmeter and circuit breaker. In new condition. Address: AL-FIN DIVISION, FARMINGDALE, N. Y.

FOR SALE

American multitable Wheelabrator, serial #A55888, size #1 with 12-8" tables and complete electrical equipment, now in operation. New cost $4860.00, priced at $2200.00. 1—36 x 60 tumbling barrel with V belt drive, price $350.00. Address: WHITEWATER MANUFACTURING CO., WHITEWATER, WISCONSIN.

HEAVY DUTY MOLDING MACHINES

1—Osborn #405-77 Jolt Rollover Pattern Draw with Oil Leveling Runout Car—Used 18 months.
1—Davenport Heavy Duty Model #48-SA Jolt Rollover Pattern Draw Machine—Used 4 months.
2—Osborn #403 Heavy Duty Jolt Rollover Pattern Draw Machines—Two years of service, excellent Condition, Low Price.
2—Osborn #560 Jolt Strippers—Like New.
All above machines for immediate delivery.

BOX 437
FOUNDRY CLEVELAND 13, OHIO

FOR SALE

Brown potentiometers—model 113661-x-17, 230 V, 60 cy, Range 550°-2000°F. Model 113661-x-53, 115 V, 60 cy, Range 0°-1200°F. $280 ea.

GEORGE KOCH SONS, INC.
10 SO. 11th AVE. EVANSVILLE, IND.

FOR SALE
IMMEDIATE DELIVERY

Ingersoll Rand, Chicago Pneumatic and Thor 1 x 8 portable grinders, Ingersoll and Chicago Pneumatic Chippers #2's & 3's. Write for price list.

No prices in excess of 60% of list.

SEATTLE PNEUMATIC TOOL CO.
535 ELLIOTT W. SEATTLE 99, WASH.

FOR SALE

1—#92 Osborn core blower
1—#55 Demmler core blower
1—#610 Johnston & Jennings rollover
1—242 Osborn jolt rollover pattern draw machine
A number of Hines aluminum flasks and jackets

BOX 463
FOUNDRY CLEVELAND 13, OHIO

FOR SALE

2—Osborn Jolt, Squeeze, Rollover, Draw Molding Machine
1—Besly 53" Surface Disc Grinder
Complete Steel Converter Production Equipment.
1—Schneible Multi-Wash Dust Collector for 6500 CFM.

GUNITE FOUNDRIES CORPORATION
ROCKFORD, ILLINOIS

NEVER USED AIR TOOLS

Chicago Pneumatic, Ingersoll-Rand, Thor, Cleco—far below list prices. Send for inventory and price list. ADDRESS: HAYNES EQUIPMENT CO., INC., 144 FULTON ST., NEW MILFORD, N. J. PHONE ORADELL 8-2683.

FOR SALE

(2) Pottstown rotary pressure blowers, never used, equipped with V Belt drive pulleys 21" diameter 10 groove complete with 10 C 90 V belts. Both blowers are flanged for 6" pipe. Shop numbers 840—11.33 x 8.126 and 840—11.33 x 8.118. These blowers available for immediate shipment at great bargain.

BAYOU INDUSTRIES INC.
ARABI, LOUISIANA

FOR SALE

1—International type JDP jolt ram power lift molding machine, lift capacity 1600 lbs. to 10 inches, lift pins length 23" centers, width adjustable from 27" to 37", Serial #600237-3-5. This machine has seen very little use and is in as good as new condition. Price for immediate sale $1500.00. Address: WHITEWATER MANUFACTURING CO., WHITEWATER, WISCONSIN.

FOR SALE

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FOR SALE

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1—International Type F Stationary 26 x 8
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1—Osborn 74W Plain Squeeze Portable
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2—SPO #611B Stationary Oscillating Jolt Squeeze Strippers
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1—Pangborn Sand Blast Unit, including generator tank, shot cleaner, bucket elevator. Suitable for use with room
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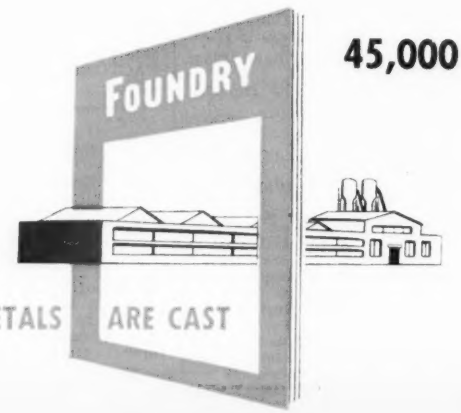

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Los Angeles correspondent Norman Lynn. Pittsburgh editor William H. Humphries, Jr., were too busy on assignments to have their pictures taken.

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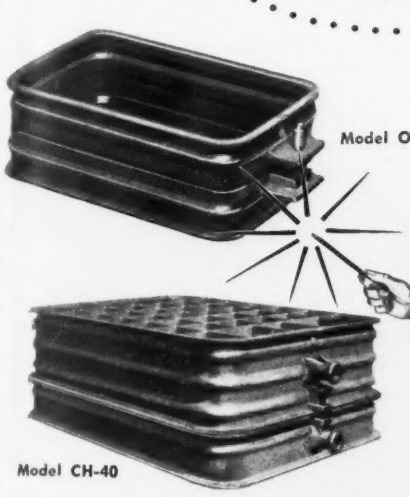
just say "*Truscon*"...



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Truscon manufactures one-man, two-man and power handled flasks available to meet your own particular production requirements.

A battery of Truscon Steel Flasks in use in a large mid-west foundry.

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TRUSCON STEEL COMPANY

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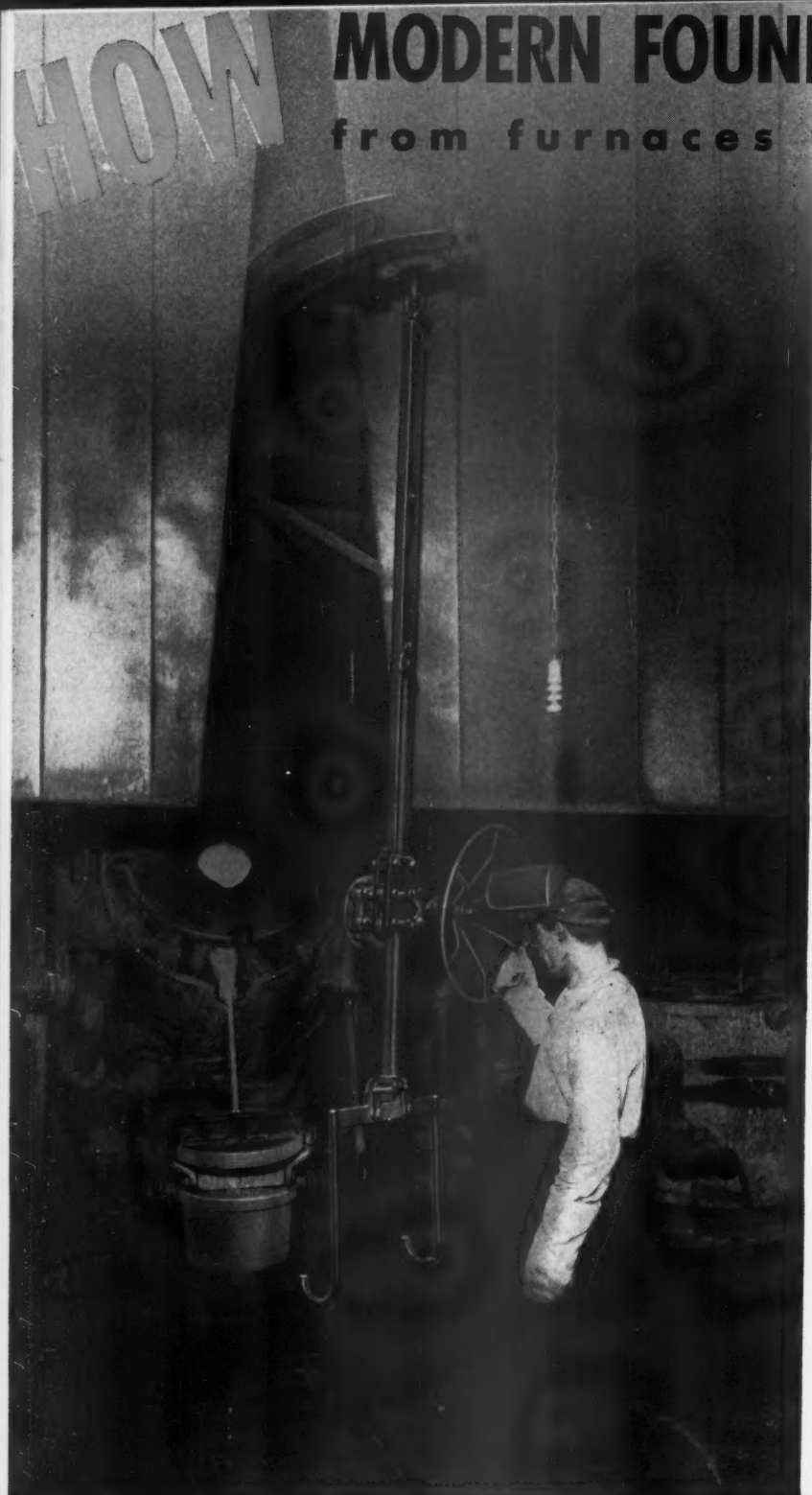
HOW MODERN FOUNDRY METHODS PAY

from furnaces to finished parts...



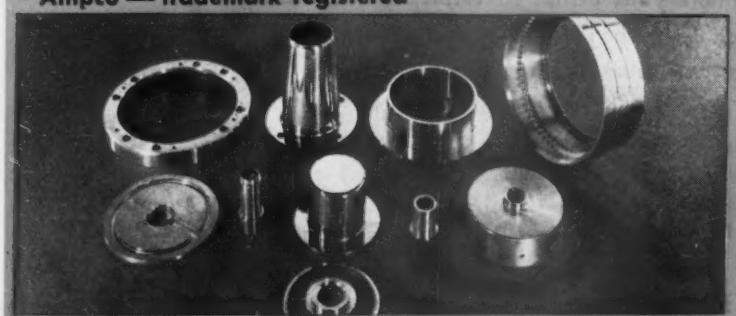
here in one of America's, prominent, non-ferrous foundries every known, modern method is put to work for safety's sake. It's a pre-planned operation that safeguards the high quality of Ampco* (aluminum bronze).

MODERN Pouring Devices with their quick-detachable bails swing into action to handle, alternately, ladles and crucibles with their heavy loads of precious metal. More perishable than fresh milk the metal flows, at highly uniform temperatures and without interruption, from covered, MODERN ladles. And right along with this maximum safety protection for men and metal, there follows an ease of operation that insures the day-after-day high yield from furnaces to loading docks.

Ampco's* turning of finished castings into finished parts is an interesting operation — as modern as it's melting and pouring methods... as practical as tomorrow's foundry planning.

Through a closely WORKING TOGETHER with successful foundrymen, here and everywhere for more than thirty years, MODERN engineers have pioneered and are continuously expanding new uses for MODERN Pouring Devices. Today there's a Device and a method for every pouring-floor-need. SO, whether you put up a couple floors a day or pour a hundred tons of metal in a round-the-clock operation it will pay you well to get the entire story. Literature and films are available to foundrymen. Returning the coupon will start things moving in your direction . . . .

Model FA Pouring Devices are quickly attached to ladle trunnions and crucible shanks with top safety for pour-off men.
*** Ampco — trademark registered**



Proving the machinability of good castings in varied machine shop practice is a plus service to Ampco* customers. Parts shown here are examples of precision work produced.

MODERN EQUIPMENT CO.
PORT WASHINGTON, WISCONSIN

MODERN EQUIPMENT COMPANY
Dept. F-7, Port Washington, Wisconsin

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Catalog on metal pouring systems	147	☐
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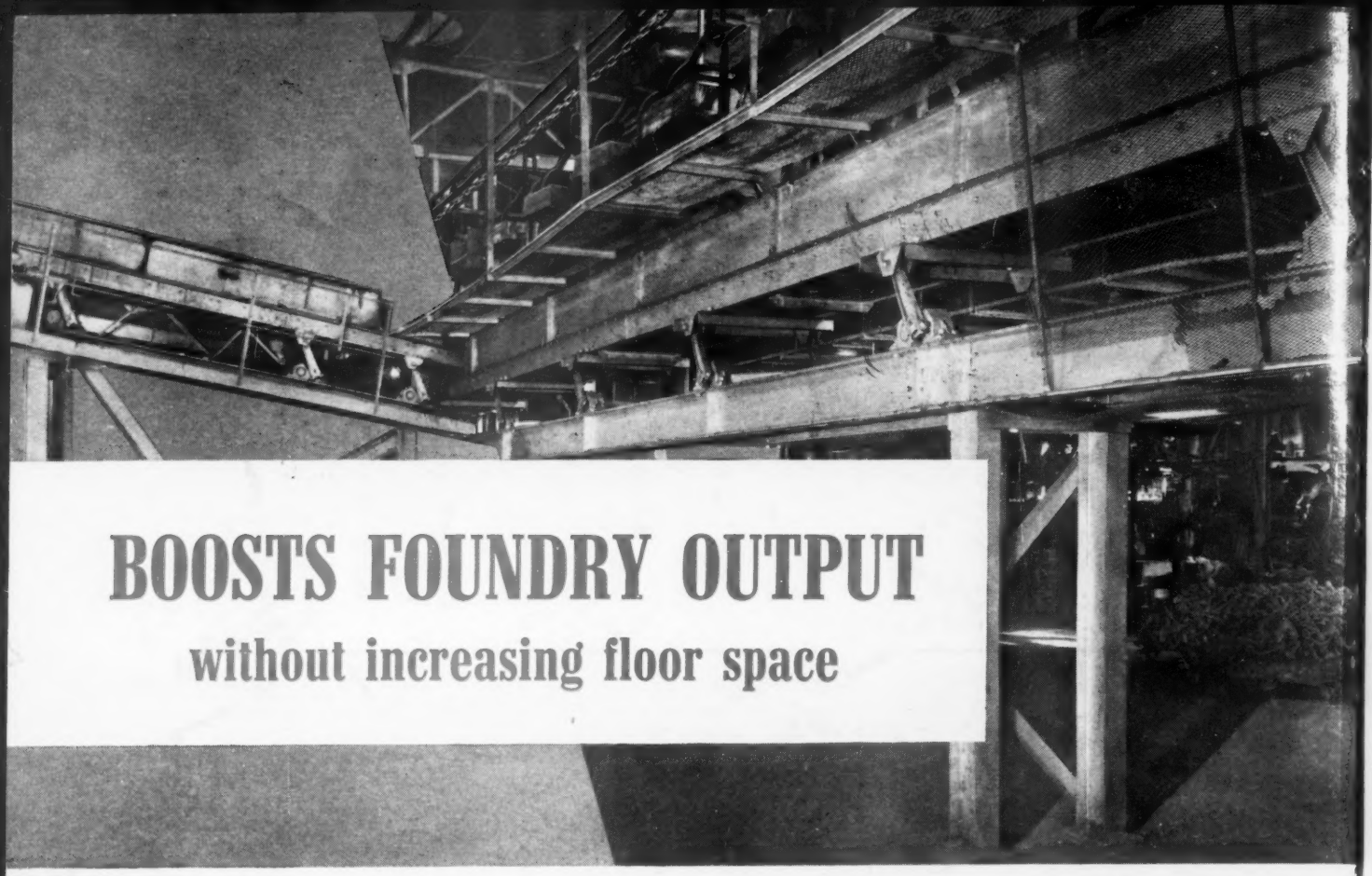


BOOSTS FOUNDRY OUTPUT

without increasing floor space

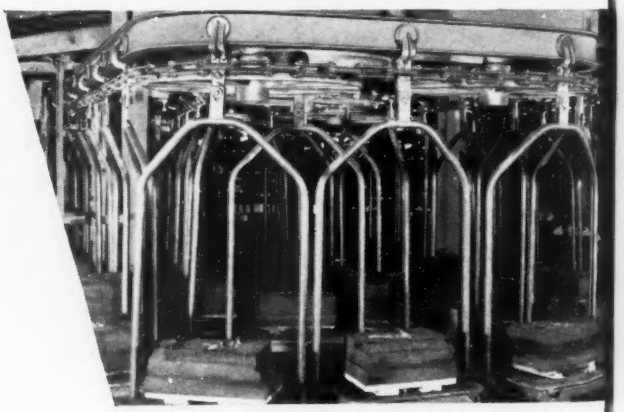
Clear of the floor, 50 ft. long Link-Belt PA Oscillating Conveyor at left transfers castings to 75 ft. long cooling Oscillating Conveyor. High-capacity exhaust hoods permit cooling in this limited space.

LINK-BELT fits complete additional foundry unit into existing building at Wagner Malleable Iron Company

Faced with the need for increased production and with little extra foundry floor space available, Wagner Malleable Iron Company of Decatur, Illinois, from past experience, called in a Link-Belt foundry specialist. By keeping equipment off the ground, Link-Belt was able to add a complete unit:

Two Link-Belt overhead trolley mold conveyors now carry the molds, sand and castings all the way from pouring, mold cooling and shakeout. Three enclosed PA oscillating conveyors utilizing forced air cooling carry the castings slowly from the shakeout screen and discharge the cooled castings to a casting sorting table. Throughout the entire operation there is no manual handling. The new installation was fitted into the existing building.

What is *your* need? A complete new foundry . . . enlarging present capacity . . . or merely replacing an individual machine? For a unique combination of engineering experience, ingenuity and quality equipment, you'll find it pays to rely on Link-Belt.



Another space-saver — Link-Belt Overhead Trolley Mold Conveyor. Here it makes a 180° turn ahead of the automatic dumping station at left.

Hand-operated plows provide selective discharge of sand to molders' hoppers from Link-Belt sand distributing Belt Conveyor at Wagner.

LINK-BELT

CONVEYORS and PREPARATION MACHINERY

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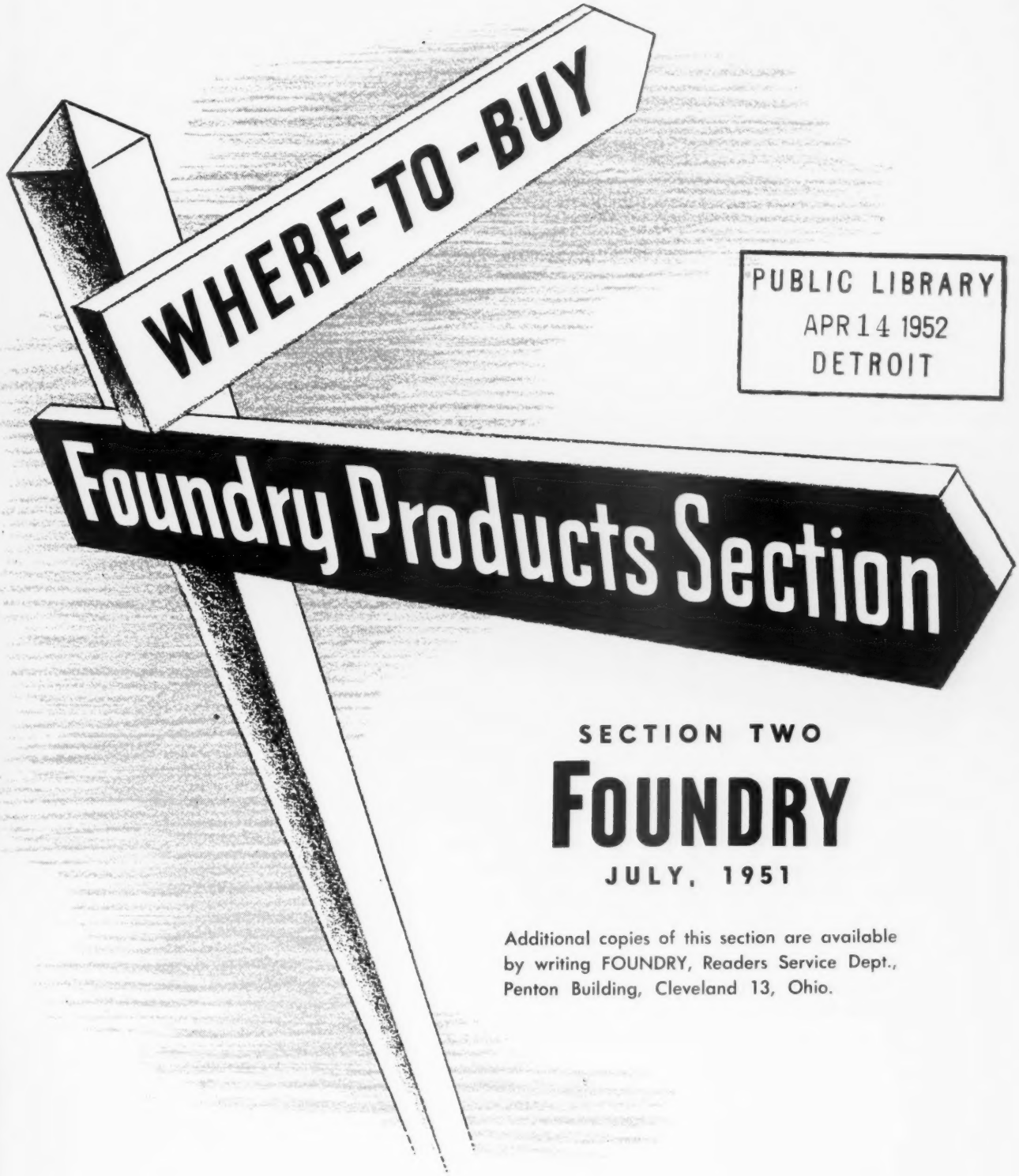

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FOUNDRY

JULY, 1951

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National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Newaygo Engineering Co., Newaygo, Mich.

AFTERCOOLERS (Compressed Air)

Jas. A. Murphy & Co., Hamilton, O.

AIR COMPRESSORS

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
Campbell-Hausfeld Co., Harrison, O.
Chicago Pneumatic Tool Co., 6 East 44th St., New York 17, N. Y.
Curtis Pneumatic Machinery Div. Curtis Mfg. Co., 1943 Kienlen Ave., St. Louis 20, Mo.
Fuller Company, Catasauqua, Pa.

AIR COMPRESSORS (Cont'd.)

Gardner-Denver Co., Gardner Drive, Quincy, Ill.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Joy Mfg. Co., Sullivan Division, Michigan City, Ind.
Schramm Inc., West Chester, Pa.
Spencer Turbine Co., Hartford, Conn.
Worthington Pump & Machinery Co., Harrison, N. J.

AIR CONDITIONING & CONTROL EQUIPMENT

Air-Way Pump & Equipment Co., 1050 N. Kilbourn, Chicago, Ill.
American Air Filter Co., Inc., 266 Central Ave., Louisville 8, Ky.
American Wheelabrator & Equipment Co., Mishawaka, Ind.
Curtis Pneumatic Machinery Div. Curtis Mfg. Co., 1943 Kienlen Ave., St. Louis 20, Mo.
Foxboro Company, Foxboro, Mass.
Hartzell Propeller Fan Co., Piqua, Ohio.
Kirk & Blum Mfg. Co., Cincinnati 25, O.
Murphy, Jas. A., & Co., Hamilton, O.
Schneible Co., Claude B., 2827—25th St., Detroit 16, Mich.
A. Schrader's Son, 470 Vanderbilt Ave., Brooklyn 17, N. Y.

AIRLESS BLAST CLEANING EQUIPMENT

American Wheelabrator & Equipment Co., Mishawaka, Ind.
Pangborn Corp., Hagerstown, Md.
W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2, Ohio.

AIR LINE LUBRICATORS

Cleco Division of Reed Roller Bit Co., Houston, Tex.

ALLOYS

Beryllium Corp., Reading, Pa.
Climax Molybdenum Co., 500 Fifth Ave., New York 18, N. Y.
Electro Refractories & Abrasive Corp., Vars Bldg., Buffalo 2, N.Y.
Federated Metals Div. American Smelting and Refining Co., 120 Broadway, New York 5, N. Y.
Frontier Bronze Corp., 818 Elmwood Ave., Niagara Falls, N. Y.
International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.
Molybdenum Corporation of America, Pittsburgh 19, Pa.
Niagara Falls Smelting & Refining Div., Continental - United Industries Co., Inc., 2204 Elmwood Ave., Buffalo 17, N. Y.
Ohio Ferro-Alloys Corp., Canton 2, O.

ALLOYS (Ferro)

Electro Metallurgical Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Hickman-Williams & Co., Union Commerce Bldg., Cleveland 14, O.
Keokuk Electro Metals Co., Keokuk, Iowa.
Miller & Company, 332 S. Michigan Ave., Chicago 4, Ill.
Ohio Ferro-Alloys Corp., Canton 2, Ohio.
Titanium Alloy Mfg. Div., National Lead Co., Hyde Park Blvd., Niagara Falls, N. Y.
Vanadium Corp. of America, 420 Lexington Ave., New York, N. Y.

ALUMINUM and ALUMINUM ALLOYS

Apex Smelting Co., 2537 West Taylor St., Chicago 12, Ill.
Christiansen Corp., 1515 No. Kilpatrick, Chicago 51, Ill.

ALUMINUM and ALUMINUM ALLOYS (Cont'd.)

Federated Metals Division, American Smelting and Refining Co., 120 Broadway, New York 5, N.Y.
Frontier Bronze Corp., 818 Elmwood Ave., Niagara Falls, N. Y.
Kaiser Aluminum & Chemical Corp., Kaiser Bldg., Oakland, Calif.
Niagara Falls Smelting & Refining Div., Continental - United Industries Co., Inc., 2204 Elmwood Ave., Buffalo 17, N. Y.
Sonken-Galamba Corp., Kansas City 18, Kansas.
U. S. Reduction Co., East Chicago, Indiana.
Western Metals Co., 3201 So. Kedzie Ave., Chicago 23, Ill.

ALUMINUM INGOTS

Apex Smelting Co., 2537 West Taylor St., Chicago 12, Ill.
Christiansen Corp., 1515 No. Kilpatrick, Chicago 51, Ill.
Federated Metals Division of American Smelting and Refining Co., 120 Broadway, New York 5, N. Y.
Kaiser Aluminum & Chemical Corp., Kaiser Bldg., Oakland, Calif.
U. S. Reduction Co., E. Chicago, Ind.
Western Metals Co., 3201 So. Kedzie Ave., Chicago 23, Ill.

ANNEALING BASKETS

Pressed Steel Co., Wilkes-Barre, Pa.

ANNEALING BOXES

Pressed Steel Co., Wilkes-Barre, Pa.

ANNEALING CORES

Pressed Steel Co., Wilkes-Barre, Pa.

ANNEALING FURNACES (Electric)

Ajax Electrothermic Corp., Trenton, N. J.
General Electric Co., Schenectady, N. Y.

ANNEALING POT RAPERS

New Haven Vibrator Co., 131 Chestnut St., New Haven 7, Conn.

ANNEALING TUBES

Pressed Steel Co., Wilkes-Barre, Pa.

ANTI-PIPING COMPOUNDS

United States Graphite Co., Saginaw, Mich.

ARGON

Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.
Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

ARRESTORS (Dust)

American Wheelabrator & Equipment Co., Mishawaka, Ind.
Kirk & Blum Mfg. Co., Cincinnati 9, Ohio.
Pangborn Corp., Hagerstown, Md.
Claude B. Schneible Co., 2827 25th St., Detroit 16, Mich.

ASSOCIATIONS

Crucible Manufacturers Association, 90 West St., New York 6, N. Y..

BAND SAWS

Atlantic Saw Mfg. Co., New Haven, Conn.

BANDS (Snap Flask)

Adams Co., Dubuque, Iowa.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

BARS (Steel)

Republic Steel Corp., 3100 E. 45th St., Cleveland 4, Ohio.

BASKETS (Annealing)

Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.
Pressed Steel Co., Wilkes-Barre, Pa.

BEARINGS (Anti-Friction, Roller and Ball)

Link-Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
Timken Roller Bearings Co., Canton 6, O.

BEARINGS (Sintered Bronze)

United States Graphite Co., Saginaw, Mich.

BELTING (Conveyor, Elevator)

Boston Woven Hose & Rubber Co., 29 Hampshire, Cambridge 39, Mass.
C. R. Daniels Inc., 4900 Block Wetheredsville Rd., Batimore 16, Md.
Hewitt Rubber Div. Hewitt-Robins Div., Inc., 240 Kensington Ave., Buffalo 5, N. Y.
Imperial Belting Co., 1800 So. Kilbourn Ave., Chicago 23, Ill.
Link-Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
Raybestos-Manhattan Inc., Manhattan Rubber Division, Passaic, N. J.

BELTS (Abrasive)

Minnesota Mining & Mfg. Co., 900 Fauquier St., St. Paul 6, Minn.

BELTS (Power Transmission)

Boston Woven Hose & Rubber Co., 29 Hampshire, Cambridge 39, Mass.
C. R. Daniels Inc., 4900 Block Wetheredsville Rd., Baltimore 16, Md.
Imperial Belting Co., 1800 So. Kilbourn Ave., Chicago 23, Ill.
Link-Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
Milwaukee Leather Belting Co., 1114 No. Water St., Milwaukee, Wis.
Raybestos-Manhattan Inc., Manhattan Rubber Division, Passaic, N. J.

BENTONITE

American Colloid Co., Merchandise Mart Plaza, Chicago 54, Ill.
Baroid Sales Division, 637 Railway Exchange Bldg., 80 East Jackson Blvd., Chicago 4, Ill.
Eastern Clay Products, Inc., Jackson, O.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

BERYLLIUM COPPER ALLOYS

Beryllium Corp., Reading, Pa.

BERYLLIUM COPPER INGOT

Beryllium Corp., Reading, Pa.

BINS (Storage)

American Bridge Co., Pittsburgh 19, Pa.
Bartlett & Snow, C. O. Co., 6201 Harvard Ave., Cleveland 5, O.

BLACKING (Mold Core)

Bloomsbury Graphite Co., Bloomsbury, N. J.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Stevens, Frederic B., Inc., Detroit 16, Mich.
United States Graphite Co., Saginaw, Mich.

BLASTING EQUIPMENT

American Wheelabrator & Equipment Co., 505 S. Byrkit St., Mishawaka, Ind.
Pangborn Corp., Hagerstown, Md.
W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2, Ohio.

BLAST METERS

Foxboro Company, Foxboro, Mass.

BLOWERS

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
American Air Filter Co., 266 Central Ave., Louisville 8, Ky.
American Wheelabrator & Equipment Co., Mishawaka, Ind.
Buffalo Forge Co., Buffalo, N. Y.
Campbell Hausfeld Co., Harrison, O.
Eclipse Fuel Engineering Co., 711 So. Main St., Rockford, Ill.
Hartzell Propeller Fan Co., Piqua, Ohio.
Ingersoll-Rand Co., 11 Broadway, New York, N. Y.
Joy Mfg. Co., La-Del Division, New Philadelphia, Ohio.
Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.
The North American Mfg. Co., 4455 E. 71st St., Ceveland 4, Ohio.
Roots-Connersville Blower Corp., Connersville, Ind.
Spencer Turbine Co., Hartford, Conn.
Stroman Furnace & Engineering Co., Division of Peterson Oven Co., 9900 Franklin Ave., Franklin Park, Ill.

BOND CLAY

American Colloid Co., Merchandise Mart Plaza, Chicago 54, Ill.
Baroid Sales Division, 637 Railway Exchange Bldg., 80 East Jackson Blvd., Chicago 4, Ill.
Eastern Clay Products Inc., Jackson, O.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Ironton Fire Brick Co., Ironton, O.

BOOKS (Technical)

Penton Publishing Co., 1213 West 3rd St., Cleveland 13, O.

BOTTOM PLATES and BOARDS

Adams Co., Dubuque, Iowa.
Black, Sivalls & Bryson, Inc., 7500 E. 12th St., Kansas City 6, Mo.
Chicago Mfg. & Distributing Co., 1928 W. 46th St., Chicago 9, Ill.
Christiansen Corp., 1515 No. Kilpatrick, Chicago 51, Ill.
Diamond Clamp & Flask Co., Richmond, Ind.
Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.
Shanafelt Mfg. Co., 3623 Winfield Way, N.E., Canton 5, Ohio.
Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.
Truscon Steel Co., Pressed Steel Div., 6100 Truscon Ave., Cleveland, Ohio.
V-G Flask & Fitting Co., Box 467, Madison, Conn.

BOWLS and SHANKS

Industrial Equipment Co., Minster, Ohio.
Whiting Corporation, 15607 Lathrop Ave., Harvey, Ill.

BOXES (Stacking)

Kirk & Blum Mfg. Co., Cincinnati 9, Ohio.

BOXES (Tote)

Brummeler Steel Products Co., Grand Rapids, Mich.
Kirk & Blum Mfg. Co., Cincinnati 9, Ohio.
Penn Iron Works, Reading, Pa.
Shanafelt Mfg. Co., 3623 Winfield Way, N.E., Canton 5, Ohio.
Truscon Steel Co., Pressed Steel Div., 6100 Truscon Ave., Cleveland, Ohio.

BRAKES (Magnetic)

Stearns Magnetic Mfg. Co., 262 S. 28th St., Milwaukee 1, Wis.

BRASS AND BRONZE INGOT

Federated Metals Division of American Smelting and Refining Co., 120 Broadway, New York 5, N. Y.
Western Metals Co., 3201 So. Kedzie Ave., Chicago 23, Ill.

BRICK (Refractory)

Carborundum Co., Perth Amboy, N. J.
General Refractories Co., 1520 Locust St., Philadelphia 2, Pa.
Harbison-Walker Refractories Co., 1745 Farmers Bank Bldg., Pittsburgh 22, Pa.
Norton Co., Worcester 6, Mass.
Titanium Alloy Mfg. Div., National Lead Co., Hyde Park Blvd., Niagara Falls, N. Y.

BRIQUETS (Alloy)

Climax Molybdenum Co., 500 Fifth Ave., New York 18, N. Y.
Electro Metallurgical Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Ohio Ferro-Alloys Corp., Canton 2, Ohio.

BRIQUETS (Ferro Alloy)

Electro Metallurgical Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Ohio Ferro-Alloys Corp., Canton 2, Ohio.

BRIQUETS (Graphite)

United States Graphite Co., Saginaw, Mich.

BRIQUETS (Manganese)

Electro Metallurgical Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

BRIQUETS (Silicon Carbide)

Carborundum Co., Perth Amboy, N. J.
Electro Refractories & Abrasive Corp., Vars Bldg., Buffalo 2, N.Y.

BRIQUETTING MACHINERY (Metal)

Milwaukee Foundry Equipment Div., Spo Inc., 3328 Pierce St., Milwaukee 4, Wis.

BRUSHES

Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, O.

BUCKETS (Elevating, Clam Shell, Drag Line, Grab, Loader, Dumping)

Blaw-Knox Co., Farmers Bank Bldg., Pittsburgh, Pa.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., Wickliffe, O.
Erie Steel Construction Co., Erie, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Pekay Machine & Engineering Co., 100 N. LaSalle St., Chicago 2, Ill.
Penn Iron Works, Reading, Pa.
Wellman Engineering Co., 7000 Central Ave., Cleveland, O.

BUFFING MACHINES

Bradford Machine Tool Co., 659 Evans St., Cincinnati, Ohio.

BUILDING and ENGINEERING SERVICE

American Bridge Co., Pittsburgh 19, Pa.

BURNERS (Acetylene, Oil, Gas, Powdered Coal, Stoker)

Eclipse Fuel Engineering Co., 711 So. Main St., Rockford, Ill.
Hauck Mfg. Co., 106 Tenth St., Brooklyn 15, N. Y.
Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.
The North American Mfg. Co., 4455 E. 71st St., Cleveland 4, Ohio.

BUSHINGS (Blow-plate)

Martin Engineering Co., Kewanee, Ill.

BUSHINGS (Flask-Pin)

Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.
Shanafelt Mfg. Co., 3623 Winfield Way, N.E., Canton 5, Ohio.
Smillie & Co., C. M., 1124 Woodward Hgts. Blvd., Ferndale 20, Mich.
Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.
Universal Engineering Co., Frankenmuth, Mich.

CALCIUM BORIDE

Molybdenum Corporation of America, Pittsburgh 19, Pa.

CALCIUM MOLYBDATE

Climax Molybdenum Co., 500 Fifth Ave., New York 18, N. Y.
Molybdenum Corporation of America, Pittsburgh 19, Pa.

CARBON BOOSTER

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
United States Graphite Co., Saginaw, Mich.

CARS (Core Oven)

Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.

CARS (Mold Drying)

Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.

CASTING GRIPS (Air Powered)

Joy Mfg. Co., Joy Division, Pittsburgh, Pa.

CASTING MACHINES (Centrifugal)

Centrifugal Casting Mach. Co., Tulsa, Okla.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.

CASTING MACHINES (Permanent Mold)

Centrifugal Casting Machine Co., Tulsa, Okla.

CASTING PLATER

United States Gypsum Co., 300 W. Adams St., Chicago, Ill.

CASTING SEALER

Empire Varnish Co., 2636 E. 76th St., Cleveland 4, Ohio.
Tincher Products Co., Sycamore 12, Illinois.
Tousey Varnish Co., 520 West 25th St., Chicago 16, Ill.

CASTINGS

City Pattern Foundry & Machine Co., 1161 Harper, Detroit 11, Mich.
Wellman Bronze & Aluminum Co., 2525 E. 93rd St., Cleveland 4, Ohio.

CEMENT (Metallic)

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Frederic B. Stevens, Inc., Detroit 16, Mich.
Smooth-On Manufacturing Co., 570 Communipaw Ave., Jersey City 4, N. J.

CEMENT (Refractory)

Bay State Abrasive Products Co., Westboro, Mass.
Carborundum Co., Perth Amboy, N. J.
Electro Refractories & Abrasive Corp., Vars Bldg., Buffalo 2, N.Y.
Harbison-Walker Refractories Co., 1745 Farmers Bank Bldg., Pittsburgh 22, Pa.
Ironton Fire Brick Co., Ironton, O.
Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.
National Crucible Co., Mermaid Lane and Queen Sts., Philadelphia 18, Pa.
Norton Co., Worcester 6, Mass.

CEREAL BINDERS

Chas. A. Krause Milling Co., 404 East State St., Milwaukee, Wis.

CHAIN (Hoist, Conveyor, Drive, Sling, etc.)

Chisholm-Moore Hoist Corp. and Columbus-McKinnon Chain Corp., Tonawanda, N. Y.
Jeffrey Mfg. Co., 907-99 N. Fourth St., Columbus, O.
Joy Mfg. Co., Joy Division, Pittsburgh, Pa.
S. G. Taylor Chain Co., Hammond, Ind.

CHAIN (Welded and Weldless)

Chisholm-Moore Corp. and Columbus-McKinnon Chain Corp., Tonawanda, N. Y.

CHAINS (Sling)

S. G. Taylor Chain Co., Hammond, Ind.

CHAPLETS

Angell Nail & Chaplet Co., 4580 E. 71st St., Cleveland, Ohio.
Cleveland Chaplet & Mfg. Co., 1197 W. 67th St., Cleveland 2, O.
Combined Supply & Equipment Co., Inc., 215 Chandler St., Buffalo 7, N. Y.
Crescent Brass & Pin Co., 5766 Trumbull Ave., Detroit, Mich.
Fanner Mfg. Co., Brookside Park, Cleveland 2, Ohio.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Milwaukee Chaplet & Mfg. Co., 1023 S. 40th St., Milwaukee 4, Wis.
Frederic B. Stevens, Inc., Detroit 16, Mich.

CHARCOAL (Briquets)

Ford Motor Co., Iron Mountain, Mich.

CHEMICALS

Atlantic Chemical & Metals Co., 1925 N. Kenmore, Chicago 14, Ill.
Hercules Powder Co., Wilmington 99, Del.
Mathieson Chemical Corp., Mathieson Bldg., Baltimore 3, Md.
Monsanto Chemical Co., 1700 S. 2nd St., St. Louis 4, Mo.

CHEMISTS

Crobaugh Co., Frank L. 1426 West Third St., Cleveland 13, Ohio.
Chas. C. Kawin Co., 431 S. Dearborn St., Chicago 5, Ill.

CHILLS

Alloy Metal Abrasive Co., 311 W. Huron St., Ann Arbor, Mich.
Angell Nail & Chaplet Co., 4580 E. 71st St., Cleveland, Ohio.
Fanner Mfg. Co., Brookside Park, Cleveland 2, Ohio.
Milwaukee Chaplet & Mfg. Co., 1023 So. 40th St., Milwaukee 4, Wis.
Standard Horse Nail Corp., New Brighton, Pa.

CHILL COATINGS

Acheson Colloids Corp., Port Huron, Mich.

CHILL NAILS

Angell Nail & Chaplet Co., 4580 E. 71st St., Cleveland, Ohio.
Capewell Mfg. Co., Hartford, Conn.
Standard Horse Nail Corp., New Brighton, Pa.

CHIPPERS—See PNEUMATIC TOOLS

CHISELS (Chipping)

Arrow Tools, Inc., 1900 S. Kostner, Chicago, Ill.
Cleco Division of Reed Roller Bit Co., Houston, Texas.
Independent Pneumatic Tool Co., Aurora, Ill.

CHROMIUM (Briquets)

Electro Metallurgical Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

CLAMPS (Flask)

Diamond Clamp & Flask Co., Richmond, Ind.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.
Sterling Wheelbarrow Co., 1700 W. Walker St., Milwaukee 14, Wis.
Truscon Steel Co., Pressed Steel Div., 6100 Truscon Ave., Cleveland, Ohio.

CLAY (Bonding)

American Colloid Co., Merchandise Mart Plaza, Chicago 54, Ill.
Carpenter Brothers, Inc., 606 West Wisconsin 3, Mo.
Baroid Sales Division, 637 Railway Exchange Bldg., 80 East Jackson Blvd., Chicago 4, Ill.
Eastern Clay Products, Inc., Jackson, O.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Harbison-Walker Refractories Co., 1745 Farmers Bank Bldg., Pittsburgh 22, Pa.
Illinois Clay Products Co., Joliet, Ill.
Ironton Fire Brick Co., Ironton, O.

CLAY (Refractory)

Carpenter Brothers, Inc., 606 West Wisconsin 3, Mo.
Eastern Clay Products Inc., Jackson, O.
Harbison-Walker Refractories Co., 1745 Farmers Bank Bldg., Pittsburgh 22, Pa.
Illinois Clay Products Co., Joliet, Ill.

CLEANING COMPOUNDS

Pelron Corp., 7740 West 47th St., Lyons, Illinois

CLEANING EQUIPMENT (Castings)

American Wheelabrator & Equipment Co., 505 S. Byrkit St., Mishawaka, Ind.
Arrow Tools Inc., 1900 S. Kostner, Chicago, Ill.
Pangborn Corp., Hagerstown, Md.

CLUTCHES (Magnetic)

Dings Magnetic Separator Co., 4740 Electric Ave., Milwaukee 7, Wis.
Stearns Magnetic Mfg. Co., 622 S. 28th St., Milwaukee 4, Wis.

COKE (Foundry)

DeBardeleben Coal Corp., 2201 First Ave., N., Birmingham 3, Ala.

COKE (Foundry) (Cont'd.)

Hickman-Williams & Co., Union Commerce Bldg., Cleveland 14, O.
Philadelphia Coke Co., 4501 Richmond St., Philadelphia 37, Pa.
Pickands, Mather & Co., Cleveland 14, O.
Republic Coal & Coke Co., 8 So. Michigan Ave., Chicago 3, Ill.
Semet Solvay Div., Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.

COKE (Petroleum)

Great Lakes Carbon Corp., 18 E. 48th St., New York 17, N. Y.
Republic Coal and Coke Co., 8 S. Michigan Ave., Chicago 3, Ill.

CONVERTER BLOWERS

Roots-Connersville Blower Corp., Connersville, Ind.

CONVERTERS (Bessemer)

Whiting Corporation, 15607 Lathrop Ave., Harvey, Ill.

CONVEYOR DESIGN

Giffels & Valet, Inc., Marquette Bldg., Detroit, Mich.

CONVEYORS (Belt)

Bartlett & Snow Co., C. O., 6201 Harvard Ave., Cleveland 5, O.
Beardsley & Piper Co., The, 2424 No. Cicero, Chicago 39, Ill.
Boston Woven Hose & Rubber Co., 29 Hampshire, Cambridge 39, Mass.
Imperial Belting Co., 1800 So. Kilbourn Ave., Chicago 23, Ill.
Jeffrey Mfg. Co., 907-99 N. Fourth St., Columbus 16, O.
Joy Mfg. Co., Joy Division, Pittsburgh, Pa.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
Logan Co., 580 Cabel, Louisville, Ky.
Mathews Conveyer Co., Ellwood City, Pa.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Robins Conveyors Div., Hewitt-Robins Inc., 270 Passaic Ave., Passaic, N. J.
Standard Conveyor Co., North St. Paul 9, Minn.

CONVEYORS (Chain)

Jeffrey Mfg. Co,, 907-99 N. Fourth St., Columbus 16, O.
Joy Mfg. Co., Joy Division, Pittsburgh, Pa.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
Logan Co., 580 Cabel, Louisville, Ky.
Mathews Conveyer Co., 104 Tenth St., Ellwood City, Pa.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Standard Conveyor Co., North St. Paul 9, Minn.

CONVEYORS (Gravity)

Logan Co., 580 Cabel, Louisville, Ky.
Mathews Conveyer Co., 104 Tenth St., Ellwood City, Pa.
Standard Conveyor Co., North St. Paul 9, Minn.

CONVEYORS (Live Roller)

Logan Co., 580 Cabel, Louisville, Ky.
Mathews Conveyer Co., Ellwood City, Pa.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Standard Conveyor Co., North St. Paul 9, Minn.

CONVEYORS (Magnetic)

Stearns Magnetic Mfg. Co., 662 S. 28th St., Milwaukee 4, Wis.

CONVEYORS (Monorail)

American Monorail Co., 13104 Athens Ave., Cleveland 7, O.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., 1155 E. 283rd St., Wickliffe, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
Mathews Conveyer Co., 104 Tenth St., Ellwood City, Pa.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Penn Iron Works, Reading, Pa.

CONVEYORS (Overhead)

Jeffrey Mfg. Co., 907 N. Fourth St., Columbus 16, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
Mathews Conveyer Co., Ellwood City, Pa.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.

CONVEYORS (Pneumatic)

Fuller Company, Catasauqua, Pa.

CONVEYORS (Portable-Gas Electric)

Joy Mfg. Co., Joy Division, Pittsburgh, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.

CONVEYORS (Rubber)

Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, O.
Standard Conveyor Co., North St. Paul 9, Minn.

CONVEYORS (Vibrating)

Ajax Flexible Coupling Co., Westfield, N. Y.
Jeffrey Mfg. Co., 907 N. Fourth St., Columbus 16, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
Robins Conveyors Div., Hewitt-Robins Inc., 270 Passaic Ave., Passaic, N. J.
Simplicity Engineering Co., Durand, Mich.
Syntron Company, Homer City, Pa.

COPPER

Federated Metals Div., American Smelting and Refining Co., 120 Broadway, New York 5, N.Y.

COPPER SHOT

Federated Metals Div., American Smelting and Refining Co., 120 Broadway, New York 5, N.Y.
Niagara Falls Smelting & Refining Div., Continental-United Industries Co., Inc., 2204 Elmwood Ave., Buffalo 17, N. Y.

CORE BINDERS

American Gum Products Co., 500 Fifth Ave., New York 18, N. Y.
Archer-Daniels-Midland Co., Werner G. Smith Div., 2191 W. 110th St., Cleveland 2, O.
Bakelite Corp., 300 Madison Ave., New York 17, N. Y.
Cities Service Oil Co., 3200 S. Western Ave., Chicago 8, Ill.
Corn Products Sales Co., 17 Battery Pl., New York 4, N.Y.
Delta Oil Products Co., Milwaukee 9, Wis.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
General Electric Co., Pittsfield, Mass.
Hercules Powder Co., Wilmington 99, Del.
E. F. Houghton Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

CORE BINDERS (Cont'd.)

Chas. A. Krause Milling Co., 404 E. State St., Milwaukee 1, Wis.
Monsanto Chemical Co., Plastic Division, Springfield 2, Mass.
Pelron Corp., 7740 West 47th St., Lyons, Illinois
Robeson Process Co., 500 Fifth Ave., New York 18, N. Y.
Frederic B. Stevens, Inc., Detroit 16, Mich.
United Oil Mfg. Co., 1429 Walnut St., Erie, Pa.
Werner G. Smith, Inc., 1730 Train Ave., Cleveland, Ohio.

CORE BLOWER BUSHINGS

Eastern Clay Products, Inc., Jackson, Ohio.
Martin Engineering Co., Kewanee, Ill.

CORE BLOWING MACHINES

Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.
Wm. Demmler & Bros., Kewanee, Ill.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Harrison Machine Co., Wesleyville, Pa.
International Molding Machine Co., LaGrange Park, Ill.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, O.
Redford Iron & Equipment Co., 20733 Glendale Ave., Detroit 23, Mich.
Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.

CORE BOXES

Accurate Match Plate Co., 1847 W. Caroll St., Chicago, Ill.
Atlas Plastic and Aluminum Pressure Plate Co., Butler, Wis.

CORE COLORING

Eaton Chemical & Dyestuff Co., 1490 Franklin, Detroit, Mich.

CORE COMPOUND

Archer-Daniels-Midland Co., Werner G. Smith Div., 2191 W. 110th St., Cleveland 2, O.
Bakelite Corp., 300 Madison Ave., New York 17, N. Y.
Cities Service Oil Co., 3200 S. Western Ave., Chicago 8, Ill.
Delta Oil Products Co., Milwaukee 9, Wis.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Pelron Corp., 7740 West 47th St., Lyons, Illinois.
Frederic B. Stevens, Inc., Detroit 16, Mich.
Werner G. Smith, Inc., 1730 Train Ave., Cleveland, Ohio.

CORE DRAWING MACHINES

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Freeman Supply Co., Toledo 5, O.
Newaygo Engineering Co., Newaygo, Mich.

CORE DRIERS (Dielectric)

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

CORE FLUXES (Aluminum, Magnesium)

Pelron Corp., 7740 West 47th St., Lyons, Illinois.

CORE GRINDERS (Power Operated)

Jeffrey Mfg. Co., Columbus 16, O.

CORE GRINDERS (Power Operated) (Cont'd.)

Milwaukee Foundry Equipment Div., Spo Inc., 3328 Pierce St., Milwaukee 4, Wis.
Standard Pattern Works, 6771 E. McNichols, Detroit 12, Mich.
Sutter Products Co., Dearborn, Mich.

CORE KNOCKOUT MACHINES

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
Beardsley & Piper Co., The, 2424 No. Cicero, Chicago 39, Ill.
Pangborn Corp., Hagerstown, Md.
Simplicity Engineering Co., Durand, Mich.

CORE MAKING MACHINES

Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.
Davenport Machine & Foundry Co., Davenport, Iowa.
Wm. Demmler & Bros., Kewanee, Ill.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Harrison Machine Co., Wesleyville, Pa.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.
International Molding Machine Co., LaGrange Park, Ill.
Milwaukee Foundry Equipment Div., Spo Inc., 3328 Pierce St., Milwaukee 4, Wis.
Redford Iron & Equipment Co., 20733 Glendale Ave., Detroit 23, Mich.
Sutter Products Co., Dearborn, Mich.
Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.
Wadsworth Equipment Co., 555 Lafollette St., Akron, Ohio.

CORE OILS

Archer-Daniels-Midland Co., Werner G. Smith Div., 2191 W. 110th St., Cleveland 2, O.
Cities Service Oil Co., 3200 S. Western Ave., Chicago 8, Ill.
Delta Oil Products Co., Milwaukee 9, Wis.
E. F. Houghton Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.
Peiron Corp., 7740 West 47th St., Lyons, Illinois
Smith Oil & Refining Co., 1102 Kilburn Ave., Rockford, Ill.
Frederic B. Stevens, Inc., Detroit 26, Mich.
United Oil Mfg. Co., 1429 Walnut St., Erie, Pa.
Werner G. Smith, Inc., 1730 Train Ave., Cleveland, Ohio.

CORE OVENS

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, O.
Despatch Oven Co., Minneapolis 14, Minn.
Drying Systems, Inc., 1801 Foster Ave., Chicago 40, Ill.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, O.
Girdler Corp., Thermex Division, 224 E. Broadway, Louisville 2, Ky.
Haynes Foundry Equipment Co., 814 Ada St., Kalamazoo, Mich.
Holcroft & Company, 6545 Epworth Blvd., Detroit 10, Mich.
Kirk & Blum Mfg. Co., Cincinnati 9, Ohio.
Lanly Company, 750 Prospect Ave., Cleveland 15, O.
J. O. Ross Engineering Corp., 444 Madison Ave., New York 17, N.Y.
Frederic B. Stevens, Inc., 18th St. & Vernor Highway, Detroit 16, Mich.

CORE PASTE

Corn Products Sales Co., 17 Battery Pl., New York 4, N. Y.
Delta Oil Products Co., Milwaukee 9, Wis.
Eastern Clay Products Co., Jackson, O.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

CORE PASTE (Cont'd.)

Frederic B. Stevens, Inc. 18th St. & Vernor Highway, Detroit 16, Mich.

CORE PLATES (Magnesium)

Christiansen Corp., 1515 No. Kilpatrick, Chicago 51, Ill.

CORE PLATES (Steel, Asbestos)

Black, Sivalls & Bryson, Inc., 7500 E. 12th St., Kansas City 6, Mo.
Diamond Clamp & Flask Co., Richmond, Indiana.
Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.
Johns-Manville, 22 E. 40th St., New York 16, N. Y.
Shanafelt Mfg. Co., 3623 Winfield Way, N.E., Canton 5, Ohio.
Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.
Truscon Steel Co., Pressed Steel Div., 6100 Truscon Ave., Cleveland, Ohio.

CORE ROD STRAIGHTENING and CUTTING MACHINERY

American Wheelabrator & Equipment Co., Mishawaka, Ind.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

CORE SAND

American Silica Sand Co., Central Life Bldg., Ottawa, Ill.
Standard Silica Corp., 209 So. LaSalle St., Chicago 4, Ill.
Titanium Alloy Mfg. Div., National Lead Co., Hyde Park Blvd., Niagara Falls, N. Y.
Weldron Silica Co., 38 So. Dearborn St., Chicago, Ill.

CORE SAND MIXERS

American Wheelabrator & Equipment Co., 505 S. Byrkit St., Mishawaka, Ind.
Baker Perkins Inc., Saginaw, Mich.
Beardsley & Piper Co., The, 2424 No. Cicero, Chicago 39, Ill.
Standard Sand & Machine Co., Blystone Div., 549 W. Washington Blvd., Chicago 6, Ill.
Clearfield Machine Co., Clearfield, Pa.
Federal Foundry Supply Co., 4600 E. 71st St. Cleveland 5, Ohio.
Multiplex Machinery Corp., Elmore, Ohio.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Posey Iron Works Inc., Lancaster, Pa.
Royer Foundry & Machine Co., Kingston, Pa.

CORE SPRAYERS

Freeman Supply Co., 1152 East Broadway, Toledo, Ohio.

CORE STRIPPERS

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

CORE TRAYS

Chicago Mfg. & Distributing Co., 1928 W. 46th St., Chicago 9, Ill.

CORE TRUCKS

Chicago Mfg. & Distributing Co., 1928 W. 46th St., Chicago 9, Ill.
Kirk & Blum Mfg. Co., Cincinnati 9, Ohio.
Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.

CORE VENTS

Demmler, Wm., & Bros., Kewanee, Ill.
Smillie, C. M. & Co., 1124 Woodward Heights Blvd., Ferndale 20, Mich.
United Compound Co., Inc., 328 South Park Ave., Buffalo 4, N. Y.

CORE WASH

Acheson Colloids Corp., Port Huron, Mich.
Bloomsbury Graphite Co., Bloomsbury, N. J.
Carborundum Co., Perth Amboy, N. J.
Cities Service Oil Co., 3200 S. Western Ave., Chicago 8, Ill.
Corn Products Sales Co., 17 Battery Pl. New York City 4.
Delta Oil Products Co., Milwaukee 9, Wis.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
E. F. Houghton Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.
National Carbon Co., Inc., Carbon Products Div., 30 E. 42nd St., New York 17, N. Y.
Smith Oil & Refining Co., 1102 Kilburn Ave., Rockford, Ill.
Stevens, Frederic B., Inc., Detroit 26, Mich.
Titanium Alloy Mfg. Div. National Lead Co., Hyde Park Blvd., Niagara Falls, N. Y.
United Oil Mfg. Co., 1429 Walnut St., Erie, Pa.
United States Graphite Co., Saginaw, Mich.

CORE WIRES

Crescent Brass & Pin Co., 5766 Trumbull Ave., Detroit, Mich.

CORES (Annealing)

Pressed Steel Co., Wilkes-Barre, Pa.

COUPLINGS (Air Line)

Cleco Division of Reed Roller Bit Co., Houston, Tex.
A. Schrader's Son 470 Vanderbilt Ave., Brooklyn 17, N. Y.

CRANE LUBRICATING SYSTEMS

Blaw-Knox Co., Farmers Bank Bldg., Pittsburgh, Pa.

CRANES (Bucket)

Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

CRANES (Electric Tramrail)

Chisholm-Moore Hoist Corp. and Columbus-McKinnon Chain Corp., Tonawanda, N. Y.

CRANES (Electric Traveling)

American MonoRail Co., 13104 Athens Ave., Cleveland 7, O.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., 1155 East 283rd St., Wickliffe, O.
Erie Steel Construction Co., Erie, Pa.
Shepard-Niles Crane & Hoist Corp., 360 Schuyler Ave., Montour Falls, N. Y.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

CRANES (Gantry)

Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., Wickliffe, Ohio
Modern Equipment Co., Port Washington, Wis.
Wellman Engineering Co., 7000 Central Ave., Cleveland 4, Ohio
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

CRANES (Hand Traveling)

American MonoRail Co., 13104 Athens Ave., Cleveland 7, Ohio
Chisholm-Moore Hoist Corp. and Columbus-McKinnon Chain Corp., Tonawanda, N. Y.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., 1155 East 283rd St., Wickliffe, O.
Modern Equipment Co., Port Washington, Wis.
Shepard-Niles Crane & Hoist Corp. Montour Falls, N. Y.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

CRANES (Jib)

American MonoRail Co., 13104 Athens Ave., Cleveland 7, O.
Chisholm-Moore Hoist Corp. and Columbus-McKinnon Chain Corp., Tonawanda, N. Y.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Modern Equipment Co., Port Washington, Wis.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

CRANES (Monorail)

American MonoRail Co., 13104 Athens Ave., Cleveland 7, O.
Chisholm-Moore Hoist Corp. and Columbus-McKinnon Chain Corp., Tonawanda, N. Y.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., 1155 East 283rd St., Wickliffe, O.
Modern Equipment Co., Port Washington, Wis.
Shepard-Niles Crane & Hoist Corp., 360 Schuyler Ave., Montour Falls, N. Y.

CRANES (Self-Propelled)

Coles Cranes Inc., 4318 So. Paulina, Chicago 9, Ill.
Silent Hoist & Crane Co., 835 63rd St., Brooklyn 20, N. Y.

CRAYONS (Marking)

Markal Co., 3052 W. Carroll, Chicago 12, Ill.

CRUCIBLES

American Crucible Co., North Haven, Conn.
Bay State Crucible Co., Taunton, Mass.
Electro Refractories & Abrasive Corp., Vars Bldg., Buffalo 2, N.Y.
Dixon, Joseph, Crucible Co., Jersey City, N. J.
Lava Crucible Co., Pittsburgh, Pa.
National Crucible Co., Mermaid Lane and Queen Sts., Philadelphia 18, Pa.
Ross-Tacony Crucible Co., Tacony, Philadelphia, Pa.
Vesuvius Crucible Co., Swissvale, Pa.

CRUCIBLE FURNACES

Ajax Electrothermic Corp., Trenton, N. J.
Campbell-Hausfeld Co., Harrison, O.
Eclipse Fuel Engineering Co., 711 So. Main St., Rockford, Ill.
Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.

CRUCIBLE LIFTERS

Modern Equipment Co., Port Washington, Wis.

CRUCIBLE POURING DEVICES

Modern Equipment Co., Port Washington, Wis.

CRUSHERS (Core)

Simplicity Engineering Co., Durand, Mich.

CUPOLAS

Foundry Service and Equipment Corp., Markham, Ill.
Modern Equipment Co., Port Washington, Wis.
Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

CUPOLA BLOWERS

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
Buffalo Forge Co., Buffalo, N. Y.
Roots-Connersville Blower Corp., Connersville, Ind.

CUPOLA BLOWERS (Cont'd.)

Spencer Turbine Co., Hartford, Conn.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

CUPOLA CHARGING MACHINES

American MonoRail Co., 13104 Athens Ave., Cleveland 7, O.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., Wickliffe, O.
Foundry Service and Equipment Corp., Markham, Ill.
Modern Equipment Co., Port Washington, Wis.
Shepard-Niles Crane & Hoist Corp., Montour Falls, N. Y.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

CUPOLA CONTROL EQUIPMENT

Edwin S. Carman, 1643 Lee Road, Cleveland 18, Ohio.
Foxboro Company, Foxboro, Mass.

CUPOLA DUST ARRESTORS

Schneible Co., Claude B., 2827—25th St., Detroit 16, Mich.

CUPOLA HOT BLAST EQUIPMENT

J. O. Ross Engineering Corp., 444 Madison Ave., New York 17, N.Y.

CUPOLA LININGS

Carborundum Co., Perth Amboy, N. J.
Cleveland Quarries Co., 1740 E. 12th St., Cleveland 14, O.
General Refractories Co., 1520 Locust St., Philadelphia 2, Pa.
Ironton Fire Brick Co., Ironton, O.
United States Graphite Co., Saginaw, Mich.

CUPOLA PATCHING GUNS

Eastern Clay Products, Inc. Jackson, Ohio.

CUPOLA SPARK ARRESTORS

Claude B. Schneible Co., 2827 25th St., Detroit 16, Mich.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

CUTOFF MACHINES (Abrasive)

Fox Grinders Inc., Oliver Bldg., Pittsburgh, Pa.
Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.

CYLINDERS (Air)

Miller Motor Co., 4027 N. Kedzie, Chicago 18, Ill.

CYLINDERS (Hydraulic)

Miller Motor Co., 4027 N. Kedzie, Chicago 18, Ill.

DARK ROOM ACCESSORIES (X-Ray)

Eastman Kodak Co., Rochester, N. Y.
General Electric X-Ray Corp., 4855 Electric Ave., Milwaukee 14, Wis.

DARK ROOM PROCESSING (Chemical Tanks, etc.)

Eastman Kodak Co., Rochester, N. Y.

DEGASIFIERS

Metalloy Corp., Rand Tower, Minneapolis 2, Minn.
Pittsburgh Metals Purifying Co., 1352 Marvista St., Pittsburgh 12, Pa.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Niagara Falls Smelting & Refining Div., Continental-United Industries Co., Inc., 2204 Elmwood Ave., Buffalo 17, N. Y.

DEOXIDIZERS

Federated Metals Div., American Smelting and Refining Co., 120 Broadway, New York 5, N. Y.
Cleveland Flux Co., 1026 Main St., Cleveland 13, O.
Metalloy Corp., Rand Tower, Minneapolis 2, Minn.
Niagara Falls Smelting & Refining Div., Continental-United Industries Co., Inc., 2204 Elmwood Ave., Buffalo 17, N. Y.
Pittsburgh Metals Purifying Co., 1352 Marvista St., Pittsburgh 12, Pa.

DEOXIDIZERS (Ferrous)

Carborundum Co., Perth Amboy, N. J.

DESULPHURIZERS

American Silica Sand Co., Central Life Bldg., Ottawa, Ill.
Cleveland Flux Co., 1026 Main St., Cleveland 13, O.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Hercules Powder Co., Wilmington 99, Del.
Mathieson Chemical Corp., 60 Mathieson Bldg., Baltimore 3, Md.
Modern Equipment Co., Port Washington, Wis.
Pittsburgh Metals Purifying Co., 1352 Marvista St., Pittsburgh 12, Pa.
Solvay Sales Division Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

DIE CASTING MACHINES

Kux Machine Co., 3930 W. Harrison St., Shicago 24, Ill.
Miller-Taylor Tool Co., 5005 Euclid Ave., Cleveland 3, Ohio.

DIES

City Pattern Foundry & Machine Co., 1161 Harper, Detroit 11, Mich.

DOWEL PINS

Standard Horse Nail Corp., New Brighton, Pa.

DRILLS (Electric)

Mall Tool Co., 7720 So. Chicago Ave., Chicago 19, Ill.
Standard Electrical Tool Co., 2488 River Road, Cincinnati 4, Ohio.

DRILLS (Pneumatic)

Gardner-Denver Co., Quincy, Ill.
Mall Tool Co., 7720 So. Chicago Ave., Chicago 19, Ill.
Schramm Inc., West Chester, Pa.

DRUMS (Magnetic)

Dings Magnetic Separator Co., 4740 Electric Ave., Milwaukee 7, Wis.
Stearns Magnetic Mfg. Co., 662 S. 28th St., Milwaukee 4, Wis.

DRYING OVENS

Drying Systems, Inc., 1801 Foster Ave., Chicago 40, Ill.

DUMP HOPPERS

Brummeler Steel Products Co., Grand Rapids, Mich.
Roura Iron Works, 1405 Woodland Ave., Detroit 11, Mich.

DUMP TRUCKS

Frank G. Hough Co., Libertyville, Ill.
Kwik-Mix Co., Port Washington Wis.
Prime Mover Co., Muscatine, Iowa.

DUST ARRESTING EQIUPMENT

American Air Filter Co., Inc. 266 Central Ave., Louisville 8, Ky.
American Wheelabrator & Equipment Co., Mishawaka, Ind.
Bartlett & Snow, C. O., Co., 6201 Harvard Ave., Cleveland 5, O.
Dracco Corp., 4063 East 116th St., Cleveland 5, Ohio.
Kirk & Blum Mfg. Co., Cincinnati 9, Ohio.
Pangborn Corp., Hagerstown, Md.
Schneible Co., Claude B., 2827—25th St., Detroit 16, Mich.
W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2, Ohio.
Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

DUST COLLECTORS

American Wheelabrator & Equipment Co., Mishawaka, Ind.
American Air Filter Co., 266 Central Ave., Louisville 8, Ky.
Bartlett & Snow, C. O., Co., 6101 Harvard Ave., Cleveland, O.
Foundry Service and Equipment Corp., Markham, Ill.
Kirk & Blum Mfg. Co., Cincinnati 9, Ohio.
Pangborn Corp., Hagerstown, Md.
Claude B. Schneible Co., 2827 25th St., Detroit 16, Mich.
W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2, Ohio.

DUST CONTROL (Chemical)

Dracco Corp., 4063 East 116th St., Cleveland 5, Ohio.

DUST RECOVERY SYSTEMS

American Wheelabrator & Equipment Co., Mishawaka, Ind.
Dracco Corp., 4063 East 116th St., Cleveland 5, Ohio.
Kirk & Blum Mfg. Co., Cincinnati 9, Ohio.
Pangborn Corp., Hagerstown, Md.

DYES & CHEMICALS

Eaton Chemical & Dyestuff Co., 1490 Franklin, Detroit, Mich.

ELECTRIC FURNACES (see Furnaces, Electric)

ELECTRODES (Graphite and Amorphous)

Great Lakes Carbon Corp., 18 E. 48th St., New York 17, N. Y.
International Graphite & Electrode Corp., St. Marys, Pa.
National Carbon Co., Inc., Electrode Sales Div., 30 E. 42nd St., New York 17, N. Y.

ELEVATORS

Standard Conveyors Co., North St. Paul 9, Minn.

ELEVATORS (Bucket)

Bartlett & Snow Co., C. O., 6201 Harvard Ave., Cleveland 5, O.
Jeffrey Mfg. Co., Columbus 16, O.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Newaygo Engineering Co., Newaygo, Mich.
Robins Conveyors Div., Hewitt-Robins Inc., 270 Passaic Ave., Passaic, N. J.

ELEVATORS (Pneumatic, Material Handling)

Fuller Co., Catasauqua, Pa.

ENGINEERING SERVICE (Foundry)

H. K. Ferguson, 1783 E. 11th St., Cleveland 14, Ohio.
Giffels & Vallet, Inc., Marquette Bldg., Detroit, Mich.
Lester B. Knight & Associates, Inc., 600 West Jackson Blvd., Chicago 3, Ill.

ENGINEERING SERVICE (Foundry) (Cont'd.)

A. H. Putnam Co., 1319 2nd Ave., Rock Island, Ill.
Westover Engineers, 3110 W. Fond du Lac Avenue, Milwaukee 10, Wis.

EXHAUST SYSTEMS

American Air Filter Co., Inc., Louisville 8, Ky.
American Wheelabrator & Equipment Co., Mishawaka, Ind.
Kirk & Blum Mfg. Co., Cincinnati 9, Ohio.
Pangborn Corporation, Hagerstown, Md.
Schneible Co., Claude B., 2827 25th St., Detroit 16, Mich.
W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2, Ohio.

FABRICATORS (Metal)

Kirk & Blum Mfg. Co., Cincinnati 9, Ohio.
Roura Iron Works, 1405 Woodland Ave., Detroit 11, Mich.

FACINGS

Acheson Colloids Corp., Port Huron, Mich.
Deta Oil Products Co., Milwaukee 9, Wis.
Joseph Dixon Crucible Co., Monmouth St., Jersey City, N. J.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
National Carbon Co., Inc., Carbon Products Div., 30 E. 42nd St., New York 17, N. Y.
Stevens Inc., Frederic B., Detroit 16, Mich.
United States Graphite Co., Saginaw, Mich.

FANS (Ventilating, Exhaust, Cooling, etc.)

American Wheelabrator & Equipment Co., Mishawaka, Ind.
Hertzell Propeller Fan Co., Piqua, Ohio.
Joy Mfg. Co., La Del Division, New Philadelphia, Ohio.
Pangborn Corp., Hagerstown, Md.

FEEDERS (Rotary)

Fuller Company, Catasauqua, Pa.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
Newaygo Engineering Co., Newaygo, Mich.

FEEDERS (Sand)

Bartlett & Snow Co., C. O., 6201 Harvard Ave., Cleveland 5, O.
Jeffrey Mfg. Co., 907 N. Fourth St., Columbus 16, O.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.

FERROBORON

Electro Metallurgical Div., Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Molybdenum Corp. of America, Pittsburgh 19, Pa.

FERROCHROME

Electro Metallurgical Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Hickman-Williams & Co., Cleveland, O.
Ohio Ferro-Alloys Corp., Canton 2, O.
Vanadium Corp., of America, 420 Lexington Ave., New York, N. Y.

FERROCOLUMBIUM

Electro Metallurgical Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

FERROMANGANESE

Electro Metallurgical Div. Union Carbide & Carbon Corp. 30 E. 42nd St., New York 17, N. Y.

Ohio Ferro-Alloys Corp. Canton 2, O.

FERROMOLYBDENUM

Climax Molybdenum Co., 500 Fifth Ave., New York 18, N. Y.

Molybdenum Corporation of America, Pittsburgh 19, Pa.

FERROSILICON

Electro Metallurgical Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

Jackson Iron & Steel Co., Jackson, O.

Keokuk Electro Metals Co., 429 So. 4th St., Keokuk, Iowa.

Miller & Company, 332 S. Michigan Ave., Chicago 4, Ill.

Ohio Ferro-Alloys Corp., Canton 2, O.

Vanadium Corp. of America, 420 Lexington Ave., New York, N. Y.

FERROTITANIUM

Electro Metallurgical Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

Titanium Alloy Mfg. Div. National Lead Co., Hyde Park Blvd., Niagara Falls, N. Y.

Vanadium Corp. of America, 420 Lexington Ave., New York, N. Y.

FERROTUNGSTEN

Electro Metallurgical Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

Molybdenum Corp. of America, Pittsburgh 19, Pa.

FERROVANADIUM

Electro Metallurgical Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

Vanadium Corp. of America, 420 Lexington Ave., New York, N. Y.

FILLET (Leather)

Milwaukee Leather Belting Co., 1114 No. Water St., Milwaukee, Wis.

FILM (X-Ray)

Eastman Kodak Co., Rochester, N. Y.

General Electric X-Ray Corp., 4855 Electric Ave., Milwaukee 14, Wis.

FILTERS (Air)

American Air Filter Co., 266 Central Ave., Louisville 8, Ky.

FIRE BRICK

Babcock & Wilcox Co., 85 Liberty St., New York 6, N. Y.

Carborundum Co., Perth Amboy, N. J.

Electro Refractories & Abrasive Corp., Vars Bldg., Buffalo 2, N.Y.

General Refractories Co., 1520 Locust St., Philadelphia 2, Pa.

Harbison-Walker Refractories Co., 1745 Farmers Bank Bldg., Pittsburgh 22, Pa.

FIRE BRICK (Con't.)

Illinois Clay Products Co., Joliet, Ill.

Norton Co., Worcester 6, Mass.

Stevens Inc., Frederic B., Detroit 16, Mich.

FIRE CLAY

Eastern Clay Products, Inc., Jackson, O.

General Refractories Co., 1520 Locust St., Philadelphia 2, Pa.

Harbison-Walker Refractories Co., 1745 Farmers Bank Bldg., Pittsburgh 22, Pa.

Illinois Clay Products Co., Joliet, Ill.

Ironton Fire Brick Co., Ironton, O.

FIRE SAND

Carborundum Co., Niagara Falls, N. Y.

Cleveland Quarries Co., 1740 E. 12th St., Cleveland 14, O.

FIRESTONE

Cleveland Quarries Co., 1740 E. 12th St., Cleveland 14, O.

FLASK BANDS

Chicago Mfg. & Distributing Co., 1928 W. 16th St., Chicago 9, Ill.

Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.

FLASK BUSHINGS

Black, Sivalls & Bryson, Inc., 7500 E. 12th St., Kansas City 6, Mo.

Hines Flask Co., 3431 W. 140 St., Cleveland 11, Ohio.

Shanafelt Mfg. Co., 3623 Winfield Way, N. E., Canton 5, Ohio.

Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.

Universal Engineering Co., Frankenmuth, Mich.

FLASK PINS

Black, Sivalls & Bryson, Inc., 7500 E. 12th St., Kansas City 6, Mo.

Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.

Shanafelt Mfg. Co., 3623 Winfield Way, N. E., Canton 5, Ohio.

Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.

Universal Engineering Co., Frankemuth, Mich.

V-G Flask & Fitting Co., Box 467, Madison, Conn.

FLASKS (Aluminum, Magnesium)

Adams Co., Dubuque, Iowa.

Diamond Clamp & Flask Co., Richmond, Indiana

Fremont Flask Co., Fremont, O.

Hines Flask Co., 3431 W. 140th St., Cleveland 11, O.

FLASKS (Dowmetal)

Fremont Flask Co., Fremont, O.

Hines Flask Co., 3431 W. 140th St., Cleveland 11, O.

FLASK FILLERS

Bartlett & Snow, C. O., Co., 6201 Harvard Ave., Cleveland 5, O.

Beardsley & Piper Co., 2424 No. Cicero, Chicago 39, Ill.

Jeffrey Mfg. Co., Columbus 16, O.

FLASKS (Slip)

Adams Co., Dubuque, Iowa.

Diamond Clamp & Flask Co., Richmond, Ind.

Freeman Supply Co., 1152 East Broadway, Toledo, Ohio.

FLASKS (Slip) (Con't.)

Fremont Flask Co., Fremont, O.

Hines Flask Co., 3431 W. 140th St., Cleveland 11, O.

Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.

FLASKS (Snap)

Adams Co., Dubuque, Iowa.

Diamond Clamp & Flask Co., Richmond, Ind.

Fremont Flask Co., Fremont, O.

Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.

Stevens, Inc., Frederic B., Detroit 16, Mich.

V-G Flask & Fitting Co., Box 467, Madison, Conn.

FLASKS (Steel)

Black, Sivalls & Bryson, Inc., 7500 E. 12th St., Kansas City 6, Mo.

Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.

Shanafelt Mfg. Co., 3623 Winfield Way, N. E., Canton 5, Ohio.

Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.

Truscon Steel Co., Pressed Steel Div., 6100 Truscon Ave., Cleveland, Ohio.

FLASK FITTINGS

Adams Co., Dubuque, Iowa.

Black, Sivalls & Bryson, Inc., 7500 E. 12th St., Kansas City 6, Mo.

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.

Shanafelt Mfg. Co., 3623 Winfield Way, N. E., Canton 5, Ohio.

Truscon Steel Co., Pressed Steel Div., 6100 Truscon Ave., Cleveland, Ohio.

V-G Flask & Fitting Co., Box 467, Madison, Conn.

FLASK LIFT MACHINES

Beardsley & Piper Co., 2424 No. Cicero, Chicago 39, Ill.

Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.

FLASK LUMBER

Dougherty Lumber Co., 4300 E. 66th St., Cleveland 5, O.

Rietz Lumber Co., 1810 N. Central Park Ave., Chicago, Ill.

FLASKS (Wood)

Adams Co., Dubuque, Iowa.

Chicago Mfg. & Distributing Co., 1928 W. 16th St., Chicago 9, Ill.

Diamond Clamp & Flask Co., Richmond, Ind.

V-G Flask & Fitting Co., Box 467, Madison, Conn.

FLEXIBLE COUPLINGS

Ajax Flexible Coupling Co., Westfield, N. Y.

FLOORING

Norton Co., Worcester 6, Mass.

Walter Maguire Co. Inc., 60 East 42nd St., New York 17, N. Y.

FLUXES

Apex Smelting Co., 2537 West Taylor St., Chicago 12, Ill.

Atlantic Chemical & Metals Co., 1925 N. Kenmore, Chicago 14, Ill.

Cleveland Flux Co., 1026 Main St., Cleveland 13, O.

Mathieson Chemical Corp., Mathieson Bldg., Baltimore 3, Md.

Niagara Falls Smelting & Refining Div., Continental-United Industries Co., Inc., 2204 Elmwood Ave., Buffalo 17, N. Y.

FLUXES (Cont'd.)

Pittsburgh Metals Purifying Co., 1352 Marvista St., Pittsburgh 12, Pa.

Puro-Seal Co., 2323 West Third, Cleveland 13, Ohio.

FLUXES (Soldering, Welding & Tinning)

Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

FOUNDRY ENGINEERS

Edwin S. Carman, 1643 Lee Road Cleveland 18, Ohio.

Lester B. Knight & Associates Inc., 600 West Jackson Blvd., Chicago 3, Oll.

A. A. Wickland Co., 205 W. Wacker Dr., Chicago 6, Ill.

FOUNDRY LAYOUT & METHODS

H. K. Ferguson Co. 1783 E. 11th St., Cleveland 14, Ohio.

Giffels & Vallet, Inc., Marquette Bldg., Detroit, Mich.

Lester B. Knight & Associates, Inc. 600 West Jackson Blvd., Chicago 3, Ill.

FOUNDRY NAILS

Capewell Mfg. Co., Hartford, Conn.

Crescent Brass & Pin Co., 5766 Trumbull Ave., Detroit, Mich.

Standard Horse Nail Corp., New Brighton, Pa.

FOUNDRY SHOVELS

(See SHOVELS)

FOUNDRY SUPPLY HOUSES

Combined Supply & Equipment Co., Inc., 215 Chandler St., Buffalo 7, N. Y.

Eastern Clay Products, Inc., Jackson, Ohio

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

Foundries Materials Co., Coldwater, Mich.

Stevens, Inc., Frederic B., Detroit 16, Mich.

FURNACES (Aluminum & Magnesium Billets)

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.

Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.

FURNACES (Aluminum & Magnesium Forgings)

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.

Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.

FURNACES (Aluminum Melting)

Ajax Engineering Corp., Trenton, N. J.

Cambell-Hausfeld Co., Harrison, O.

Eclipse Fuel Engineering Co., 711 So. Main St., Rockford, Ill.

FURNACES (Aluminum Rivet Heating)

Ajax Electric Co., Inc., Philadelphia 23, Pa.

FURNACES (Annealing)

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.

Despatch Oven Co., Minneapolis 14, Minn.

FURNACES (Annealing) (Cont'd.)

Eclipse Fuel Engineering Co., 711 So. Main St., Rockford, Ill.
Electric Furnace Co., West Wilson St., Salem, Ohio.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.
Holcroft & Company, 6545 Epworth Blvd., Detroit 10, Mich.
Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.

FURNACES (Crucible Melting)

Ajax Eltrothermic Corp., Trenton, N. J.
Campbell-Hausfeld Co., 300-320 Moore St., Harrison, O.
Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.
Stroman Furnace & Engineering Co., Div. of Peterson Oven Co., 9900 Franklin Ave., Franklin Park, Ill.

FURNACES (Electric Melting)

Ajax Electric Furnace Corp., 46 Richmond St., Philadelphia 23, Pa.
Ajax Electrothermic Corp., Trenton, N. J.
Ajax Engineering Corp., Trenton, N. J.
American Bridge Co., Pittsburgh 19, Pa.
Detroit Electric Furnace Div. of Kuhlman Electric Co., Bay City, Mich.
Pittsburgh Lectromelt Furnace Corp., P.O. Box 1125, Pittsburgh, Pa.
Whiting Corporation, 15607 Lathrop Ave., Harvey, Ill.

FURNACES (Gas or Oil Fired)

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
Campbell-Hausfeld Co., Harrison, O.
Carl-Mayer Corp., 3030 Euclid Ave. Cleveland 15, Ohio.
Eclipse Fuel Engineering Co. 711 So. Main St., Rockford, Ill.
Electric Furnace Co., West Wilson St., Salem, Ohio.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.
Lanly Company, 750 Prospect Ave., Cleveland 15, Ohio.
Lindberg Engineering Co., Fisher Furnaces Div., 2450 West Hubbard, Chicago 12, Ill.
Reda Pump Co., Bartlesville, Okla.
Stroman Furnace & Engineering Co., Div. of Peterson Oven Co., 9900 Franklin Ave., Franklin Park, Ill.

FURNACES (Gray Iron Melting)

American Bridge Co., Pittsburgh 19, Pa.
Detroit Electric Furnace Div. of Kuhlman Electric Co., Bay City, Mich.
Pittsburgh Lectromelt Furnace Corp., P.O. Box 1125, Pittsburgh Pa.
Reda Pump Co., Bartlesville, Oklahoma

FURNACES (Heat Treating)

Ajax Electric Co., Inc., Philadelphia 23, Pa.
Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio
Despatch Oven Co., Minneapolis 14, Minn.
Eclipse Fuel Engineering Co., 711 So. Main St., Rockford, Ill.
Electric Furnace Co., West Wilson St., Salem, Ohio.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.
Holcroft & Company, 6545 Epworth Blvd., Detroit 10, Mich.
Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.

FURNACES, HEAT TREATING (Electric)

Ajax Electric Co., Inc., Philadelphia 23, Pa.
Ajax Electrothermic Corp., Trenton, N. J.
Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.
Despatch Oven Co., Minneapolis 14, Minn.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.

FURNACES (Induction Heating)

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
Russ-Holt Corp., 1311 Chestnut St., Chattanooga 2, Tenn.

FURNACES (Malleable Annealing)

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.
Electric Furnace Co., West Wilson St., Salem, Ohio.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.
General Electric Co., Schenectady, N. Y.
Holcroft & Company, 6545 Epworth Blvd., Detroit 10, Mich.
Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.
Whiting Corporation, 15607 Lathrop Ave., Harvey, Ill.

FURNACES (Malleable Melting)

American Bridge Co., Pittsburgh 19, Pa.
Pittsburgh Lectromelt Furnace Corp., P.O. Box 1125, Pittsburgh, Pa.
Whiting Corporation, 15607 Lathrop Ave., Harvey, Ill.

FURNACES (Nonferrous Melting)

Ajax Electrothermic Corp., Trenton, N. J.
Ajax Engineering Corp., Trenton, N. J.
Campbell-Hausfeld Co., Harrison, O.
Detroit Electric Furnace Div. of Kuhlman Electric Co., Bay City, Mich.
Eclipse Fuel Engineering Co., 711 So. Main St., Rockford, Ill.
Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.
Reda Pump Co., Bartlesville, Oklahoma
Stroman Furnace & Engineering Co., Div. of Peterson Oven Co., 9900 Franklin Ave., Franklin Park, Ill.

FURNACES (Powdered Coal)

Foundry Service and Equipment Corp., Markham, Ill.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

FURNACES (Steel Melting)

Ajax Electrothermic Corp., Trenton, N. J.
American Bridge Co., Pittsburgh 19, Pa.
Detroit Electric Furnace Div. of Kuhlman Electric Co., Bay City, Mich.
Pittsburgh Lectromelt Furnace Corp., P.O. Box 1125, Pittsburgh, Pa.

FURNACE BLOWERS

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
Campbell-Hausfeld Co., Harrison, O.
Joy Mfg. Co., La-Del Division, New Philadelphia, Ohio.
Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.
Roots-Connersville Blower Corp., Connersville, Ind.

FURNACE LININGS

Campbell-Hausfeld Co., Harrison, O.
Carborundum Co., Perth Amboy, N. J.
Electro Refractories & Abrasive Corp., Vars Bldg., Buffalo 2, N.Y.
Ironton Fire Brick Co., Ironton, O.
Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.
National Carbon Co. Inc., Carbon Products Div., 30 E. 42nd St., New York 17, N. Y.
Stroman Furnace & Engineering Co., Div. of Peterson Oven Co., 9900 Franklin Ave., Franklin Park, Ill.
Titanium Alloy Mfg. Div., National Lead Co., Hyde Park Blvd., Niagara Falls, N. Y.
United States Graphite Co., Saginaw, Mich.

GAGGERS

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Wadsworth Equipment Co., 555 Lafollette St., Akron, Ohio.

GAS (Oxygen, Acetylene, Industrial)

Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.
Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

GAS BURNERS

Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard St., Chicago 12, Ill.

GENERATORS (Acetylene)

Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

GLOVES (Industrial, Safety)

American Optical Co., Southbridge, Mass.
United States Rubber Co., 4300 New Haven Ave., Ft. Wayne 4, Ind.

GOGGLES and EYE PROTECTORS

American Optical Co., Southbridge, Mass.
B. F. McDonald Co., 5112 South Hoover St., Los Angeles 37, Calif.
Willson Products Inc., Reading, Pa.

GRAPHITE

Acheson Colloids Corp., Port Huron, Mich.
Bloomsbury Graphite Co., Bloomsbury, N. J.
Joseph Dixon Crucible Co., Monmouth St., Jersey City, N. J.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
International Graphite & Electrode Corp., St. Marys, Pa.
National Carbon Co. Inc., Carbon Products Div., 30 E. 42nd St., New York 17.
United States Graphite Co., Saginaw, Mich.

GRAPHITIZER

United States Graphite Co., Saginaw, Mich.

GRINDERS (Electric Portable)

Chicago Pneumatic Tool Co., 6 East 44th St., New York 17, N. Y.
Independent Pneumatic Tool Co., Aurora, Ill.
Mall Tool Co., 7720 So. Chicago Ave., Chicago 19, Ill.
Rotor Tool Co., 17325 Euclid Ave., Cleveland 12, Ohio.

GRINDERS (Electric Portable) (Cont'd.)

Standard Electrical Tool Co., 2488 River Road, Cincinnati 4, Ohio.

GRINDERS (Flexible Shaft)

Mall Tool Co., 7720 So. Chicago Ave., Chicago 19, Ill.

GRINDERS (Hand)

Chicago Wheel & Mfg. Co., 1101 W. Monroe, Chicago 7, Ill.

GRINDERS (Pneumatic Portable)

Chicago Pneumatic Tool Co., 6 East 44th St., New York 17, N. Y.
Cleco Pneumatic Tool Div., Reed Roller Bit Co., Houston, Tex.
Independent Pneumatic Tool Co., Aurora, Ill.
Master Pneumatic Tool Co., Inc., Orwell, Ohio.
Rotor Tool Co., 17325 Euclid Ave., Cleveland 12, Ohio.

GRINDERS (Surface, Bench, Disc, Floor)

Bradford Machine Tool Co., 659 Evans St., Cincinnati, Ohio.
Fox Grinders, Inc., Oliver Bldg., Pittsburgh 22, Pa.
Independent Pneumatic Tool Co., Aurora, Ill.
Standard Electrical Tool Co., 2488 River Road, Cincinnati 4, Ohio.

GRINDERS (Swing Frame)

Fox Grinders, Inc., Oliver Bldg., Pittsburgh 22, Pa.
Sutter Products Co., Dearborn, Mich.

GRINDING WHEELS—See ABRASIVE WHEELS

GRINDING WHEEL DRESSERS

Carborundum Co., Niagara Falls, N. Y.
Desmond-Stephens Mfg. Co., Urbana, O.

GRINDSTONES

Cleveland Quarries Co., 1740 E. 12th St., Cleveland 14, Ohio
Bay State Abrasive Products Co., Westboro, Mass.
Sterling Grinding Wheel Division, Cleveland Quarries Co., Tiffin, Ohio

GRIT (Abrasive)

Alloy Metal Abrasive Co., Ann Arbor, Mich.
American Steel Abrasives Co., Galion, O.
American Wheelabrator & Equipment Co., Mishawaka, Ind.
Carborundum Co., Niagara Falls, N. Y.
Clayton Sherman Abrasives Co., 3896 Lonyo Rd., Detroit 10, Mich.
Cleveland Metal Abrasive Co., 887 E. 67th St., Cleveland, Ohio.
Hickman-Williams & Co., Union Commerce Bldg., Cleveland 14, O.
Metal Blast, Inc., 871 E. 67th St., Cleveland, Ohio.
Pangborn Corp., Hagerstown, Md.
Pittsburgh Crushed Steel Co., Pittsburgh 1, Pa.

HAMMERS (Chipping)

Arrow Tools Inc., 1900 S. Kostner, Chicago, Ill.
Chicago Pneumatic Tool Co., 6 East 44th St., New York 17, N. Y.

HAMMERS (Chipping) Cont'd.

Cleco Pneumatic Tool Div., Reed Roller Bit Co., Houston, Texas.
Dayton Pneumatic Tool Co., Dayton 1, Ohio.
Independent Pneumatic Tool Co., Aurora, Ill.
Joy Mfg. Co., Sullivan Division, Michigan City, Ind.
Master Pneumatic Tool Co., Inc., Orwell, Ohio.
Schramm Inc., West Chester, Pa.

HARDNESS TESTING EQUIPMENT

Detroit Testing Machine Co., 19390 Grinnell Ave., Detroit 13, Mich.
Harry W. Dietert Co., 9330A Roselawn Ave., Detroit 4, Mich.
Foxboro Company, Foxboro, Mass.
Claude S. Gordon Co. 3000 So. Wallace, Chicago 16, Ill.
Illinois Testing Laboratories, Inc. 418 N. LaSalle St., Chicago 10, Ill.

HEAT CONTROL AND RECORDING DEVICES

Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.
Marshall Co., L. H., 270 W. Lane, Columbus 1, O.

HEATERS (Gas, Oil, Electric)

American Wheelabrator & Equipment Co., Mishawaka, Ind.
Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio
Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.
Lanly Co., 750 Prospect Ave., Cleveland 15, Ohio.
J. O. Ross Engineering Corp. 444 Madison Ave., New York 17, N.Y.

HEATERS (High Frenquency Electric)

Ajax Electrothermic Corp., Trenton, N. J.

HEATERS (Indirect Fired)

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.

HEATERS (Space, Unit, Direct Fired)

Dravo Corp., Neville Island, Pittsburgh 25, Pa.
Drying Systems, Inc., 1801 Foster Ave., Chicago 40, Ill.

HEATERS (Space, Unit, Oven, Water)

American Wheelabrator & Equipment Co., Mishawaka, Ind.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.

HELMETS (Blasting)

American Wheelabrator & Equipment Co., Mishawaka, Ind.
American Optical Co., Southbridge, Mass.
B. F. McDonald Co., 5112 South Hoover St., Los Angeles 37, Calif.
Pangborn Corp., Hagerstown, Md.
W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2, Ohio.

HELMETS (Welding)

American Optical Co., Southbridge, Mass.

HOISTS (Air)

Chicago Pneumatic Tool Co., 6 East 44th St., New York 17, N. Y.
Curtis Pneumatic Machinery Div. Curtis Mfg. Co., 1943 Kienlen Ave., St. Louis 20, Mo.
Gardner-Denver Co., Quincy, Ill.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Joy Mfg. Co., Sullivan Division, Michigan City, Ind.
Miller Motor Co., 4027 N. Kedzie, Chicago 18, Ill.

HOISTS (Chain)

Chisholm-Moore Hoist Corp. and Columbus-McKinnon Chain Corp., Tonawanda, N. Y.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., 1155 East 283rd St., Wickliffe, O.

HOISTS (Electric)

Chisholm-Moore Hoist Corp. and Columbus-McKinnon Chain Corp., Tonawanda, N. Y
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., 1155 East 283rd St., Wickliffe, O.
Joy Mfg. Co., Sullivan Division, Michigan City, Ind.
Modern Enquipment Co., Port Washington, Wis.
Shepard-Niles Crane & Hoist Corp., Montour Falls, N. Y.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

HOISTS (Hand)

Chisholm-Moore Hoist Corp. and Columbus-McKinnon Chain Corp., Tonawanda, N. Y.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., Wickliffe, Ohio.

HOISTS (Skip)

Beardsley & Piper Co., The, 2424 No. Cicero, Chicago 39, Ill.
Gardner-Denver Co., Quincy, Ill.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Robins Conveyors Div., Hewitt-Robins Inc., 270 Passaic Ave., Passaic, N. J.
Whiting Corporation, 15601 Lathrop Ave., Harvey, Ill.

HOODS (Shakeout, Pouring & Cooling)

Claude B. Schneible Co., 2827 25th St., Detroit 16, Mich.

HOPPERS (Sand)

Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.

HOSE (Air, Blasting, Water, Gas)

Boston Woven Hose & Rubber Co., 29 Hampshire, Cambridge 39, Mass.
Gardner-Denver Co., Quincy, Ill.
Hewitt Rubber Div. Hewitt-Robins Div., Inc., 240 Kensington Ave., Buffalo 5, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.
Pangborn Corp., Hagerstown, Md.
Raybestos-Manhattan, Inc., Manhattan Rubber Div., Passaic, N. J.
Schramm Inc., West Chester, Pa.

HOSE FITTINGS

Boston Woven Hose & Rubber Co., 29 Hampshire, Cambridge 39, Mass.
A. Schrader's Son, 417 Vanderbilt Ave., Brooklyn 17, N. Y.

HOSE REELS

A. Schrader's Son, 470 Vanderbilt Ave., Brooklyn 17, N. Y.

HYDRAULIC CLEANING EQUIPMENT

Pangborn Corp., Hagerstown, Md.

HYDRO FINISHING EQUIPMENT

Pangborn Corp., Hagerstown, Md.

IDENTIFICATION PENCILS

Markal Co., 3052 W. Caroll, Chicago 12, Ill.

ILLUMINATORS (X-Ray Films)

Eastman Kodak Co., Rochester, N. Y.

IMPREGNATING SYSTEMS

Empire Varnish Co., 2636 E. 76th St., Cleveland 4, O.
Tincher Products Co., Sycamore 12, Ill.

INDUSTRIAL ENGINEERING SERVICE

Lester B. Knight & Associates, Inc., 600 West Jackson Blvd., Chicago 3, Ill.

INGOT MOLDS

Acme Foundry Co., Detroit 16, Mich.

INGOTS (Magnesium)

Christiansen Corp., 1515 No. Kilpatrick, Chicago

INGOTS (Nonferrous)

Apex Smelting Co., 2537 West Taylor St., Chicago 12, Ill.
Christiansen Corp., 1515 No. Kilpatrick, Chicago 51, Ill.
Federated Metals Div. of American Smelting and Refining Co., 120 Broadway, New York 5.
Frontier Bronze Corp., 818 Elmwood Ave., Niagara Falls, N. Y.
International Nickel Co., Inc., 67 Wall St., New York City 5.
Kaiser Aluminum & Chemical Corp., Kaiser Bldg., Oakland, Calif.
R. Lavin & Sons Inc., 3426 So. Kedzie Ave., Chicago 23, Ill.
Northwestern Iron & Metal Co., 900 "T" Street, Lincoln, Nebraska.
Sonken-Galamba Corp., Kansas City 18, Kansas.
Western Metals Co., 3201 So. Kedzie Ave., Chicago 23, Ill.

INOCULANTS

Carborundum Co., Perth Amboy, N. J.
United States Graphite Co., Saginaw, Mich.

IRON CEMENT

Smooth-On Mfg. Co., 570 Communipaw Ave., Jersey City 4, N. J.

IRON ORE

Pickands, Mather & Co., Cleveland 14, O.

IRON OXIDES

Chicago Mfg. & Distributing Co., 1928 W. 46th St., Chicago 9, Ill.
Delta Oil Products Co., Milwaukee 9, Wis.
Tamms Industries Inc., 228 N. LaSalle St., Chicago 1, Ill.

JACKETS (Mold)

Adams Co., Dubuque, Iowa.
Chicago Mfg. & Distributing Co., 1928 W. 46th St., Chicago 9, Ill.
Diamond Clamp & Flask Co., Richmond, Ind.
Fremont Flask Co., Fremont, O.
Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.
Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.

LABORATORY EQUIPMENT (Chemical)

Harry W. Dietert Co., 9330A Roselawn Ave., Detroit 4, Mich.

LABORATORY EQUIPMENT (Physical)

Harry W. Dietert Co., 9330A Roselawn Ave., Detroit 4, Mich.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
National Forge & Ordnance Co., Irvine, Warren Co., Pa.
Norton Co., Worcester 6, Mass.

LADLES

Industrial Equipment Co., Minster, O.
Industrial Fabricating, Inc., 817 Hall St., Eaton Rapids, Mich.
Modern Equipment Co., Port Washington, Wis.
Frederic B. Stevens, Inc., Detroit 16, Mich.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

LADLE LININGS

General Refractories Co., 1520 Locust St., Philadelphia 2, Pa.
Harbison-Walker Refractories Co. 1745 Farmers Bank Bldg., Pittsburgh 22, Pa.
Ironton Fire Brick Co., Ironton, Ohio.
United States Graphite Co., Saginaw, Mich.

LEAD

Federated Metals Div., American Smelting and Refining Co., 120 Broadway, New York 5.

LIFT TRUCKS

Frank G. Hough Co., Libertyville, Ill.
Towmotor Corp., 1226 East 152nd St., Cleveland 10, Ohio

LINSEED OIL

Hercules Powder Co., Wilmington 99, Del.

LOADERS

Clearfield Machine Co., Clearfield, Pa.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.

LOADERS (Tractor-Mounted)

Frank G. Hough Co., Libertyville, Ill.

LUBRICANTS (Industrial)

Acheson Colloids Corp., Port Huron, Mich.
Smith Oil & Refining Co., 1102 Kilburn Ave., Rockford, Ill.
United States Graphite Co., Saginaw, Mich.

MACHINE KEYS

Standard Horse Nail Corp., New Brighton, Pa.

MACHINISTS VISES

Columbian Vise & Mfg. Co., 9021 Bessemer Ave., Cleveland, Ohio

MAGNESIUM (Ingots)

Apex Smelting Co., 2537 West Taylor St., Chicago 12, Ill.
Federated Metals Division of American Smelting and Refining Co., 120 Broadway, New York 5, N.Y.

MAGNET CONTROLLERS

Ohio Electric Mfg. Co., 5906 Maurice Ave., Cleveland, Ohio.

MAGNETS

Dings Magnetic Separator Co., 4740 Electric Ave., Milwaukee 7, Wis.
Ohio Electric Mfg. Co., 5906 Maurice Ave., Cleveland, Ohio.
Stearns Magnetic Mfg. Co., 662 S. 28th St., Milwaukee 4, Wis.

MARKING CRAYONS

Markal Co., 3052 W. Carroll, Chicago 12, Ill.

MATCH PLATE METAL

Federated Metals Division of American Smelting and Refining Co., 120 Broadway, New York 5, N.Y.

MATCHPLATES

Accurate Match Plate Co., 1847 W. Carroll St., Chicago, Ill.
Atlas Plastic and Aluminum Pressure Plate Co., Butler, Wis.
Central Pattern Co., Quincy, Ill.
Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.
City Pattern Foundry & Machine Co,. 1161 Harper, Detroit 11, Mich.
Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.
Plaster Process Castings Co., 6922 Carnegie Ave., Cleveland 3, O.
Scientific Cast Products Corp., 1388-92 E. 40th St., Cleveland 3, O.

MATERIALS HANDLING EQUIPT.

Frank G. Hough Co., Libertyville, Ill.

MECHANICAL ENGINEERS

Giffels & Vallet, Inc., Marquette Bldg., Detroit, Mich.

MELTING POTS

Acme Foundry Co., Detroit 16, Mich.

METAL CASTING PLASTER

United States Gypsum Co., 300 W. Adams St., Chicago, Ill.

METAL CLEANING EQUIPMENT

American Wheelabrator & Equipment Co., Mishawaka, Ind.
Pangborn Corp., Hagerstown, Md.

METALLOGRAPHIC EQUIPMENT

Harry W. Dietert Co., 9330A Roselawn Ave., Detroit 4, Mich.
General Electric X-ray Corp., 4855 Electric Ave., Milwaukee 14, Wis.

METALLURGICAL CHEMISTS

Chas. C. Kawin Co., 431 S. Dearborn St., Chicago 5, Ill.

METALLURGISTS

Crobaugh Co., Frank L., 1426 West Third St., Cleveland 13, Ohio.

METERS (Gas, Air, Water)

Illinois Testing Laboratories, Inc., 418 N. LaSalle St., Chicago 10, Ill.
Roots-Connersville Blower Corp., Connersville, Ind.

MIXERS (Core Wash)

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Multiplex Machinery Corp., Elmore, Ohio.

MIXERS (Sand and Clay)

American Wheelabrator & Equipment Co., 505 S. Byrkit St., Mishawaka, Ind.
Beardsley & Piper Co., The, 2424 No. Cicero, Chicago 39, Ill.
Blystone Division, Standard Sand & Machine Co., 549 W. Washington Blvd., Chicago 6, Ill.
Clearfield Machine Co., Clearfield, Pa.
Construction Machinery Co., Waterloo, Iowa.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, Ohio.
Jeffrey Mfg. Co., 907 N. Fourth St., Columbus 16, O.
Multiplex Machinery Corp., Elmore, Ohio.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Posey Iron Works, Inc., Lancaster, Pa.
Royer Foundry & Machine Co., Kingston, Pa.

MOLD CONVEYORS

Bartlett & Snow, C. O., Co., 6201 Harvard Ave., Cleveland 5, O.
Beardsley & Piper Co., The, 2424 No. Cicero, Chicago 39, Ill.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Jeffrey Mfg. Co., 907-99 N. Fourth St., Columbus 16, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
Logan Co., 580 Cabel. Louisville, Ky.
Mathews Conveyer Co., Ellwood City, Pa.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Newago Engineering Co., Newago, Mich.

MOLD OVENS and DRYERS

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.
Despatch Oven Co., Minneapolis 14, Minn.

MOLD OVENS & DRYERS (Cont'd.)

Drying Systems, Inc. 1801 Foster Ave., Chicago 40, Ill.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, O.
Lanly Company, 750 Prospect Ave., Cleveland 15, O.
J. O. Ross Engineering Corp., 444 Madison Ave., New York 17, N.Y.

MOLD WASH

Acheson Colloids Corp., Port Huron, Mich.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
National Carbon Co., Inc., Carbon Products Div., 30 E. 42nd St., New York 17, N. Y.
Frederic B. Stevens, Inc., 18th St. & Vernor Highway, Detroit 16, Mich.
United States Graphite Co., Saginaw, Mich.

MOLDING MACHINES

Adams Co., Dubuque, Iowa.
Beardsley & Piper Co., The, 2424 N. Cicero, Chicago 39, Ill.
Berkshire Mfg. Co., 1111 Power Ave., Cleveland 14, Ohio.
Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.
Davenport Machine & Foundry Co., Davenport, Iowa.
Haynes Foundry Equipment Co., 814 Ada St., Kalamazoo, Mich.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.
International Molding Machine Co., LaGrange Park, Ill.
Johnston & Jennings Div., Pettibone-Mulliken Corp., 2424 No. Cicero Ave., Chicago 39, Ill.
Milwaukee Foundry Equipment Div. Spo Inc., 3328 W. Pierce St., Milwaukee 4, Wis.
Nicholls, Wm. H., Co., Richmond Hill, Long Island 18, N. Y.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, O.
S. P. O. Incorporated, 7500 Grand Division Ave., Cleveland 5, O.
Sutter Products Co., Dearborn, Mich.
Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.

MOLDING MACHINES (Jolt)

Adams Co., Dubuque, Iowa.
Champion Foundry & Machine Co., 1553 West Madison St., Chicago 7, Ill.
Davenport Machine & Foundry Co., Davenport, Iowa.
Haynes Foundry Equipment Co., 814 Ada St., Kalamazoo, Mich.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.
International Molding Machine Co., LaGrange Park, Ill.
Johnston & Jennings Div., Pettibone-Mulliken Corp., 2424 No. Cicero Ave., Chicago 39, Ill.
Milwaukee Foundry Equipment Div., Spo Inc., 3328 Pierce St., Milwaukee 4, Wis.
Nicholls, Wm. H., Co., Richmond Hill, Long Island 18, N. Y.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, O.
S. P. O. Incorporated, 7500 Grand Division Ave., Cleveland 5, O.
Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.

MOLDING MACHINES (Rollover)

Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.
Davenport Machine & Foundry Co., Davenport, Iowa.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.
Johnston & Jennings Div., Pettibone-Mulliken Corp., 2424 No. Cicero Ave., Chicago 39, Ill.
Milwaukee Foundry Equipment Div., Spo Inc., 3328 Pierce St., Milwaukee 4, Wis.

MOLDING MACHINES (Rollover) (Cont'd)

Nicholls, Wm. H., Co., Richmond Hill, Long Island 18, N. Y.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, O.
S. P. O. Incorporated, 7500 Grand Division Ave., Cleveland 5, O.
Sutter Products Co., Dearborn, Mich.
Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.

MOLDING MACHINES (Squeeze)

Adams Co., Dubuque, Iowa.
Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.
Davenport Machine & Foundry Co., Davenport, Iowa.
Haynes Foundry Equipment Co., 814 Ada St., Kalamazoo, Mich.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.
International Molding Machine Co., LaGrange Park, Ill.
Johnston & Jennings Div., Pettibone-Mulliken Corp. 2424 No. Cicero Ave., Chicago 39, Ill.
Milwaukee Foundry Equipment Div., Spo Inc., 3328 Pierce St., Milwaukee 4, Wis.
Nicholls, Wm. H., Co., Richmond Hill, Long Island 18, N. Y.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, Ohio.
S. P. O. Incorporated, 7500 Grand Division Ave., Cleveland 5, O.
Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.

MOLDING SANDS

American Silica Sand Co., Central Life Bldg., Ottawa, Ill.
Foundries Materials Co., Coldwater, Mich.
Ottawa Silica Co., Ottawa, Ill.
Standard Silica Corp., 209 So. LaSalle St., Chicago 4, Ill.
Wedron Silica Co., 38 So. Dearborn St., Chicago, Ill.

MOLYBDENUM

Molybdenum Corporation of America, Pittsburgh 19, Pa.

MONOGRAMS & TRADE MARKS

H. P. Maughlin Co., 953 Ingleside Ave., Columbus, Ohio.

MONORAIL SYSTEMS

American Monorail Co., 13104 Athens Ave., Cleveland 7, O.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., 1155 East 283rd St., Wickliffe, O.
Link-Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
Modern Equipment Co., Port Washington, Wis.

MOTORS (Electric)

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
Ohio Electric Mfg. Co., 5906 Maurice Ave., Cleveland, Ohio.

NAILS (Chill)

Angell Nail & Chaplet Co., 4580 E. 71st St., Cleveland 5, O.
Capewell Mfg. Co., Hartford, Conn.
Crescent Brass & Pin Co., 5766 Trumbull Ave., Detroit, Mich.
Republic Steel Corp., 3100 E. 45th St., Cleveland 4, Ohio.
Standard Horse Nail Corp., New Brighton, Pa.

NICKEL

International Nickel Co., Inc., 67 Wall St., New York City 5.

NITROGEN

Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.
Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

NOZZLES (Blasting)

Alloy Metal Abrasives Co., 311 W. Huron St., Ann Arbor, Mich.
American Wheelabrator & Equipment Co., 505 S. Byrkit St., Mishawaka, Ind.
Davenport Machine & Foundry Co., Davenport, Iowa.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Norton Co., Worcester 6, Mass.
Pangborn Corp., Hagerstown, Md.
W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2, Ohio.

OIL BURNERS

Hauck Manufacturing Co., 106 Tenth St., Brooklyn 15, N. Y.
Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.
Stroman Furnace & Engineering Co., Div. of Peterson Oven Co., 9900 Franklin Ave., Franklin Park, Ill.

OPEN HEARTH DOORS

Wm. M. Bailey Co., Pittsburgh 16, Pa.

OVENS (Annealing and Heat Treating)

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.
Despatch Oven Co., Minneapolis 14, Minn.
Electric Furnace Co., West Wilson St., Salem, Ohio.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.
Lanly Company, 750 Prospect Ave., Cleveland 15, O.
Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.
Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

OVENS (Core) (See CORE OVENS)

OVENS (Enameling, Japanning)

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.
Despatch Oven Co., Minneapolis 14, Minn.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.
Kirk & Blum Mfg. Co., Cincinnati 9, Ohio
Lanly Co., 750 Prospect Ave., Cleveland 15, Ohio.

OVENS (Mold Drying)

Carl-Mayer Corp., 3030 Euclid Ave., Cleveland 15, Ohio.
Despatch Oven Co., Minneapolis 14, Minn.
Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.
Kirk & Blum Mfg. Co., Cincinnati 9, Ohio
Lanly Co., 750 Prospect Ave., Cleveland 15, Ohio.

OXYGEN

Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.
Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

PAINTS (Graphite)

Joseph Dixon Crucible Co., Monmouth St., Jersey City, N. J.

PARTING COMPOUND (Silicone)

Dow Corning Corp., Midland, Mich.

PARTING COMPOUNDS

Acheson Colloids Corp., Port Huron, Mich.
Delta Oil Products Co., Milwaukee 9, Wis.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
E. F. Houghton Co., 303 W. Lehigh Ave., Philadelphia 33, Pa.

PARTING COMPOUNDS (Cont'd.)

Smith Oil & Refining Co., 1102 Kilburn Ave., Rockford, Ill.

Frederic B. Stevens, Inc., Detroit 16, Mich.

Tamms Industries Inc., 228 N. LaSalle St., Chicago 1, Ill.

PATTERN COATINGS

Acheson Colloids Corp., Port Huron, Mich.

American Lacquer Solvents Co., Phoenixville, Pa.

McDougall-Butler Co., 2929 Main St., Buffalo 14, N. Y.

PATTERN COMPOUND

Tamms Industries Inc., 228 N. LaSalle St., Chicago 1, Ill.

PATTERN LETTERS

Freeman Supply Co., 1152 East Broadway, Toledo, Ohio.

H. P. Maughlin Co., 953 Ingleside Ave., Columbus, Ohio.

PATTERN LUMBER

Dougherty Lumber Co., Cleveland 5, O.

Freeman Supply Co., 1152 East Broadway, Toledo, Ohio.

Rietz Lumber Co., 1810 N. Central Park Ave., Chicago, Ill.

PATTERNMAKER'S VISES

Columbian Vise & Mfg. Co., 9021 Bessemer Ave., Cleveland, Ohio.

PATTERN METAL

Federated Metals Division of American Smelting and Refining Co., 120 Broadway, New York 5, N. Y.

Niagara Falls Smelting & Refining Div., Continental-United Industries Co. Inc., 2204 Elmwood Ave., Buffalo 17, New York

PATTERN PLASTER

United States Gypsum Co., 300 W. Adams St., Chicago, Ill.

PATTERN PLATES

Accurate Match Plate Co., 1847 W. Carroll St., Chicago, Ill.

Atlas Plastic and Aluminum Pressure Plate Co., Butler, Wis.

Buffalo Pattern Works, 830 Hertel Ave., Buffalo, N. Y.

City Pattern Foundry & Machine Co., 1161 Harper, Detroit 11, Mich.

Freeman Supply Co., 1152 East Broadway, Toledo, Ohio.

Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.

Plaster Process Castings Co., 6922 Carnegie Ave., Cleveland 3.

Scientific Cast Products Corp., 1388-92 E. 40th St., Cleveland 3, O.

PATTERN SHOP EQUIPMENT

Freeman Supply Co., 1152 East Broadway, Toledo, Ohio.

Milwaukee Leather Belting Co., 1114 No. Water St., Milwaukee, Wis.

Oliver Machinery Company, Grand Rapids 2, Mich.

PATTERNS (Plastic)

Atlas Plastic and Aluminum Pressure Plate Co., Butler, Wis.

Central Pattern Co., Quincy, Ill.

PATTERNS (Wood, Metal)

Accurate Match Plate Co., 1847 W. Carroll St., Chicago, Ill.

Atlas Plastic and Aluminum Pressure Plate Co., Butler, Wis.

Buffalo Pattern Works, 830 Hertel Ave., Buffalo, N. Y.

Central Pattern Co., Quincy, Ill.

City Pattern Foundry & Machine Co., 1161 Harper, Detroit 11, Mich.

Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.

Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.

S.P.O. Incorporated, 7500 Grand Division Ave., Cleveland 5, O.

Wellman Bronze & Aluminum Co., 2525 E. 93rd St., Cleveland 4, O.

PERMANENT MOLDS

Centrifugal Casting Machine Co., Tulsa, Okla.

PHOSPHOR COPPER

Federated Metals Division of American Smelting and Refining Co., 120 Broadway, New York 5, N.Y.

Niagara Falls Smelting & Refining Div. Continental-United Industries Co. Inc., 2204 Elmwood Ave., Buffalo 17, N. Y.

PHOTOGRAPHIC EQUIPMENT

Eastman Kodak Co., Rochester, N. Y.

General Electric X-Ray Corp., 4855 Electric Ave., Milwaukee 14, Wis.

PHOTOGRAPHY (Industrial)

Eastman Kodak Co., Rochester, N. Y.

PIG CASTING MACHINES

Wm. M. Bailey Co., Pittsburgh 16, Pa.

PIG IRON

Hickman-Williams & Co., Union Commerce Bldg., Cleveland 14, O.

Jackson Iron & Steel Co., Jackson, Ohio.

Keokuk Electro Metals Co., 429 So. 4th St., Keokuk, Iowa.

Miller & Company, 332 S. Michigan Ave., Chicago 4, Ill.

Pickands, Mather & Co., Cleveland 14, O.

Republic Steel Corp., 3100 E. 45th St., Cleveland 4, Ohio.

Woodward Iron Co., Woodward, Ala.

PIG IRON (Silvery)

Jackson Iron & Steel Co., Jackson, O.

Keokuk Electro Metals Co., 429 So. 4th St., Keokuk, Iowa.

Miller & Company, 332 S. Michigan Ave., Chicago 4, Ill.

PINS (Flask)

Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.

Shanafelt Mfg. Co., 3623 Winfield Way, N.E., Canton 5, Ohio.

Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.

Truscon Steel Co., Pressed Steel Div., 6100 Truscon Ave., Cleveland, Ohio.

Universal Engineering Co., Frankenmuth, Mich.

V-G Flask & Fitting Co., Box 467, Madison, Conn.

PISTON RINGS (for Molding Machines, Compressors, etc.)

Nicholls, Wm. H., Co., Richmond Hill, Long Island 18, N. Y.

PLANT ENGINEERING SERVICE

H. K. Ferguson Co., 1783 E. 11th St., Cleveland 14, Ohio.

Giffels & Vallet, Inc., Marquette Bldg., Detroit, Mich.

Lester B. Knight & Associates, Inc., 600 West Jackson Blvd., Chicago 3, Ill.

PLASTER OF PARIS

United States Gypsum Co., 300 W. Adams St., Chicago, Ill.

PLATES (Bottom)

Adams Co., Dubuque, Iowa.

Christiansen Corp., 1515 No. Kilpatrick, Chicago 51, Ill.

Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.

PLATES (Core Drying)

Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.

Christiansen Corp., 1515 No. Kilpatrick, Chicago 51, Ill.

Johns-Manville, 22 East 40th St., New York 16.

PLUMBAGO

Bloomsbury Graphite Co., Bloomsbury, N. J.

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

Frederic B. Stevens, Inc., Detroit 16, Mich.

United States Graphite Co., Saginaw, Mich.

PNEUMATIC TOOLS

Arrow Tools Inc., 1900 S. Kostner, Chicago, Ill.

Chicago Pneumatic Tool Co., 6 East 44th St., New York 17, N. Y.

Cleco Pneumatic Tool Div., Reed Roller Bit Co., Houston, Texas.

Dayton Pneumatic Tool Co., Dayton 1, Ohio.

Gardner-Denver Co., Quincy, Ill.

Independent Pneumatic Tool Co., Aurora, Ill.

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

Joy Mfg. Co., Sullivan Division, Michigan City, Ind.

Master Pneumatic Tool Co., Inc., Orwell, Ohio.

Rotor Tool Co., 17325 Euclid Ave., Cleveland 12, Ohio.

Schramm Inc., West Chester, Pa.

POLISHING MACHINES

Bradford Machine Tool Co., 659 Evans St., Cincinnati, Ohio.

POURING DEVICES

Industrial Equipment Co., Minster, Ohio.

Modern Equipment Co., Port Washington, Wis.

Whiting Corp., 15607 Lathrop Ave., Harvey, Ill.

PRESSER BOARDS

Adams Co., Dubuque, Iowa.

Chicago Mfg. & Distributing Co., 1928 W. 46th St., Chicago 9, Ill.

Christiansen Corp., 1515 No. Kilpatrick, Chicago 51, Ill.

V-G Flask & Fitting Co., Box 467, Madison, Conn.

PRESSURE RECORDERS

Foxboro Company, Foxboro, Mass.

PROTECTIVE MATERIALS (X-Ray)

General Electric X-Ray Corp., 4855 Electric Ave., Milwaukee 14, Wis.

PULLEYS (Magnetic)

Dings Magnetic Separator Co., 4740 Electric Ave., Milwaukee 7, Wis.

Homer Mfg. Co., Lima, Ohio.

Stearns Magnetic Mfg. Co., 662 S. 28th St., Milwaukee 4, Wis.

PUMPS

Construction Machinery Co., Waterloo, Iowa.

Gardner-Denver Co., Quincy, Ill.

Worthington Pump & Machinery Co., Harrison, N. J.

PUMPS (Dry, Vacuum)

Allis Chalmers Mfg. Co., Milwaukee 1, Wis.

Fuller Company, Catasauqua, Pa.

Roots-Connersville Blower Corp., Connersville, Ind.

PURIFIERS

Cleveland Flux Co., 1026 Main St., Cleveland 13, O.

PUSH-OFF MACHINES

Beardsley & Piper Co., 2424 N. Cicero, Chicago 39, Ill.

Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.

International Molding Machine Co., LaGrange Park, Ill.

Milwaukee Foundry Equipment Div. Spo Inc., 3238 W. Pierce St., Milwaukee 4, Wis.

PUTTY (Foundry)

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

PYROMETERS

Elematic Equipment Corp., 1150 W. Marquette, Chicago 2, Ill.

Foxboro Company, Foxboro, Mass.

Harry W. Dietert Co., 9330A Roselawn Ave., Detroit 4, Mich.

Claude S. Gordon Co., 3000 So. Wallace, Chicago 16, Ill.

Illinois Testing Laboratories, Inc., 418 N. LaSalle St., Chicago 10, Ill.

Marshall Co., L. H., 270 W. Lane Columbus 1, O.

Pyrometer Instrument Co., Bergenfield, N. J.

Tamms Industries Inc., 228 N. LaSalle St., Chicago 1, Ill.

PYROMETERS (Immersion)

Pyrometer Instrument Co., Bergenfield, N. J.

PYROMETERS (Optical)

Pyrometer Instrument Co., Bergenfield, N. J.

RACKS (Core Ovens)

Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.

Kirk & Blum Mfg. Co., Cincinnati 9, Ohio.

RADIOGRAPHY (Industrial)

Eastman Kodak Co., Rochester, N. Y.

Radium Chemical Co., Inc., 570 Lexington Ave., New York 22, N. Y.

RADIUM

Radium Chemical Co., Inc., 570 Lexington Ave., New York 22, N. Y.

REFRACTORIES

Babcock & Wilcox Co., 85 Liberty St., New York 6, N. Y.

Carborundum Co., Niagara Falls, N. Y.

Carborundum Co., Perth Amboy, N. J.

Cleveland Quarries Co., 1740 E. 12th St., Cleveland 14, O.

REFRACTORIES (Cont'd.)

Joseph Dixon Crucible Co., Monmouth St., Jersey City, N. J.
Eastern Clay Products, Inc., Jackson, O.
Electro Refractories & Abrasive Corp., Vars Bldg., Buffalo 2, N.Y.
General Refractories Co., 1520 Locust St., Philadelphia 2, Pa.
Harbison-Walker Refractories Co., 1745 Farmers Bank Bldg., Pittsburgh 22, Pa.
Ironton Fire Brick Co., Ironton, O.
Lindberg Engineering Co., Fisher Furnace Div., 2450 West Hubbard, Chicago 12, Ill.
National Crucible Co., Mermaid Lane and Queen Sts., Philadelphia 18, Pa.
Norton Co., Worcester 6, Mass.
Richard C. Remmey Son Co., Hedley St. & Delaware River, Philadelphia 37, Pa.
Frederic B. Stevens, Inc., 18th St. & Vernor Highway, Detroit 16, Mich.
Titanium Alloy Mfg. Div., National Lead Co., Hyde Park Blvd., Niagara Falls, N. Y.
United States Graphite Co., Saginaw, Mich.

REGULATORS (Gas or Oil)

The North American Mfg. Co., 4455 E. 71st St., Cleveland 4, Ohio.

RESPIRATORS

Wilson Products Inc., Reading, Pa.

RIDDLES (Electric)

Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Foundry Supplies & Mfg. Co., 2221 Orchard St., Chicago 14, Ill.
Great Western Mfg. Co., Leavenworth, Kans.

RIDDLES (Hand)

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Frederic B. Stevens, Inc., 18th St. & Vernor Highway, Detroit 16, Mich.

RISERS (Blind)

Dodge Steel Co., State Road & Hellerman St., Philadelphia, Pa.

ROD DIP

Smith Oil & Refining Co., 1102 Kilburn Ave., Rockford, Ill.

ROD STRAIGHTENERS

American Wheelabrator & Equipment Co., Mishawaka, Ind.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

ROLLER-HEARTH FURNACES (Electric Annealing)

General Electric Co., Schenectady, N. Y.
Holcroft & Company, 6545 Epworth Blvd., Detroit 10, Mich.

RUBBER LINING MATERIAL (Abrasive Resisting)

Pangborn Corp., Hagerstown, Md.

SAFETY CLOTHING

American Optical Co., Southbridge, Mass.
B. F. McDonald Co., 5112 South Hoover St., Los Angeles 37, Calif.
Pangborn Corp., Hagerstown, Md.

SALT & SALT TABLETS

U. S. Safety Service Co., 1215 McGee St., Kansas City 6, Mo.

SAND ARRESTER TUBES

Martin Engineering Co., Kewanee, Ill.

SAND (Core, Molding, Blasting)

American Silica Sand Co., Central Life Bldg., Ottawa, Ill.
Carpenter Brothers, Inc., 606 West Wisconsin, Milwaukee 3, Wis.
Ottawa Silica Co., Ottawa, Ill.
Pangborn Corp., Hagerstown, Md.
Producers Core Sand Corp., Michigan City, Ind.

SAND (Core, Molding, Blasting) (Cont'd.)

Standard Silica Corp., 209 So. LaSalle St., Chicago 4, Ill.
Titanium Alloy Mfg. Div., National Lead Co., Hyde Park Blvd., Niagara Falls, N. Y.
Wedron Silica Co., 38 So. Dearborn St., Chicago, Ill.

SAND BLAST BARRELS

American Wheelabrator & Equipment Co., 505 S. Byrkit St., Mishawaka, Ind.
Pangborn Corp., Hagerstown, Md.
Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.
W. W. Sly Mfg. Co., 4753 Train Ave,. Cleveland 2, Ohio.

SAND BLAST CABINETS

American Wheelabrator & Equipment Co., 505 S. Byrkit St., Mishawaka, Ind.
Pangborn Corp., Hagerstown, Md.

SAND BLAST EQUIPMENT

American Air Filter Co., 266 Central Ave., Louisville 8, Ky.
American Wheelabrator & Equipment Co., 505 S. Byrkit St., Mishawaka, Ind.
Pangborn Corp., Hagerstown, Md.
W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2, Ohio.
Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.

SAND BLAST NOZZLES

American Wheelabrator & Equipment Co., Mishawaka, Ind.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Norton Company, Worcester 6, Mass.
Pangborn Corp., Hagerstown, Md.
W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2, Ohio.

SAND BLAST ROOMS

American Wheelabrator & Equipment Co., Washawaka, Ind.
Pangborn Corp., Hagerstown, Md.
W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2, Ohio.

SAND BLAST TABLES

American Wheelabrator & Equipment Co., Mishawaka, Ind.
Pangborn Corp., Hagerstown, Md.
W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2, Ohio.

SAND CONTROL & TESTING EQUIPMENT

Beardsley & Piper Co., 2424 No. Cicero, Chicago 39, Ill.
Harry W. Dietert Co., 9330A Roselawn Ave., Detrot 4, Mich.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.

SAND CONVEYING and HANDLING EQUIPMENT

Ajax Flexible Coupling Co., Westfield, N. Y.
American Air Filter Co., Louisville 8, Ky.
C. O. Bartlett & Snow Co., 6201 Harvard Ave., Cleveland 5, O.
Beardsley & Piper Co., The, 2424 No. Cicero, Chicago 39, Ill.
Clearfield Machine Co., Clearfield, Pa.
Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., Wickliffe, Ohio.
Frank G. Hough Co., Libertyville, Ill.
Jeffrey Mfg. Co., 907-99 N. Fourth St., Columbus 16, O.
Joy Mfg. Co., Joy Division, Pittsburgh, Pa.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Newaygo Engineering Co., Newaygo, Mich.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland, 14, O.
Pekay Machine & Engineering Co., 100 N. LaSalle St., Chicago 2, Ill.
Penn Iron Works, Reading, Pa.
Royer Foundry & Machine Co., Kingston, Pa.

SAND CONVEYING and HANDLING EQUIPMENT (Pneumatic)

Fuller Company, Catasauqua, Pa.
Robins Conveyors Div., Hewitt-Robins Inc., 270 Passaic Ave., Passaic, N. J.

SAND COOLING SYSTEMS

Newaygo Engineering Co., Newaygo, Mich.

SAND DRYERS

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
Bartlett & Snow Co., C. O., 6201 Harvard Ave., Cleveland 5, Ohio.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
Nichols Engineering & Research Corp., 70 Pine St., New York 5, N. Y.

SANDERS (Pneumatic)

Cleco Division of Reed Roller Bit Co., Houston, Texas.

SANDING MACHINERY (Disc, Spindle, Belt, etc.)

Freeman Supply Co., 1152 E. Broadway, Toledo 5, Ohio.
Oliver Machinery Company, Grand Rapids 2, Mich.

SAND MEASURING and WEIGHING DEVICES

Baker Perkins Inc., Saginaw, Mich.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.

SAND MIXERS

American Wheelabrator & Equipment Co., Mishawaka, Ind.
Baker Perkins Inc., Saginaw, Mich.
Beardsley & Piper Co., The, 2424 N. Cicero, Chicago 39, Ill.
Standard Sand & Machine Co., Blystone Division, 549 W. Washington Blvd., Chicago 6, Ill.
Clearfield Machine Co., Clearfield, Pa.
Construction Machinery Corp., Waterloo, Iowa.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, Ohio.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
Multiplex Machinery Corp., Elmore, Ohio.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Royer Foundry & Machine Co., Kingston, Pa.

SAND PREPARATION EQUIPMENT

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
American Wheelabrator & Equipment Co., Mishawaka, Ind.
Baker Perkins Inc., Saginaw, Mich
Bartlett & Snow Co., C. O., 6201 Harvard Ave., Cleveland 5, O.
Beardsley & Piper Co., The, 2424 N. Cicero, Chicago 39, Ill.
Clearfield Machine Co., Clearfield, Pa.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, Ohio.
Jeffrey Mfg. Co., 907-99 N. Fourth St., Columbus 16, O.
Moulders Friend, Dallas City, Ill.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, O.
Royer Foundry & Machine Co., Kingston, Pa.
Simplicity Engineering Co., Durand, Mich.

SAND RAMMERS

Chicago Pneumatic Tool Co., 6 East 44th St., New York 17, N. Y.
Cleco Pneumatic Tool Div., Reed Roller Bit Co., Houston, Texas.
Dayton Pneumatic Tool Co., Dayton 1, O.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.
Master Pneumatic Tool Co., Inc., Orwell, Ohio.
Rotor Tool Co., 17325 Euclid Ave., Cleveland 12, Ohio.

SAND RECLAIMERS

Jeffrey Mfg. Co., 907 N. Fourth St., Columbus 16, O.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Nichols Engineering & Research Corp., 70 Pine St., New York 5, N. Y.
Stearns Magnetic Mfg. Co., 662 S. 28th St., Milwaukee 4, Wis.

SAND SIFTING and SCREENING MACHINERY

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
American Air Filter Co., Louisville 8, Ky.
Bartlett & Snow, C. O., Co., 6201 Harvard Ave., Cleveland 5, Ohio.
Beardsley & Piper Co., The, 2424 N. Cicero, Chicago 39, Ill.
Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Foundry Supplies & Mfg. Co., 2221 Orchard St., Chicago 14, Ill.
Great Western Mfg. Co., Leavenworth, Kansas.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Royer Foundry & Machine Co., Kingston, Pa.
Simplicity Engineering Co., Durand, Mich.
Pangborn Corp., Hagerstown, Md.
Whiting Corporation, 15607 Lathrop Ave., Harvey, Ill.

SAND STORAGE BINS & GATES

Bartlett & Snow, C. O., Co., 6201 Harvard Ave., Cleveland 5, Ohio.
Beardsley & Piper Co., The, 2424 No. Cicero, Chicago 39, Ill.
Jeffrey Mfg. Co., Columbus 16, O.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.

SAWS (Band, Metal, Wood)

Atlantic Saw Mfg. Co., New Haven, Conn.
Oliver Machinery Company, Grand Rapids 2, Mich.

SAWS (Cold Metal)

Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.

SCALES

Toledo Scale Co., Toledo, Ohio.

SCALING HAMMERS

Joy Mfg. Co., Sullivan Division, Michigan City, Ind.
Rotor Tool Co., 17325 Euclid Ave., Cleveland 12, Ohio.
Schramm, Inc., West Chester, Pa.

SCREENS (Shake-Out)

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
Bartlett & Snow, C. O., Co., 6201 Harvard Ave., Cleveland 5, Ohio.

SCREENS (Shake-Out) (Cont'd.)

Beardsley & Piper Co., 2424 N. Cicero, Chicago 39, Ill.
Jeffrey Mfg. Co., 907 N. Fourth St., Columbus 16, O.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Simplicity Engineering Co., Durand, Mich.

SCREENS (Vibrating)

Ajax Flexible Coupling Co., Westfield, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
Robins Conveyors Div., Hewitt-Robins Inc., 270 Passaic Ave., Passaic, N. J.
Simplicity Engineering Co., Durand, Mich.

SEA COAL

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Frederic B. Stevens, Inc., Detroit 16, Mich.

SEPARATORS (Abrasive)

American Wheelabrator & Equipment Co., Mishawaka, Ind.
Pangborn Corp., Hagerstown, Md.

SEPARATORS (Air, Moisture, Oil)

American Air Filter Co., Louisville 8, Ky.
American Wheelabrator & Equipment Co., Mishawaka, Ind.
Jas. A. Murphy & Co., Hamilton, O.
Pangborn Corp., Hagerstown, Md.
A. Schrader's Son, 470 Vanderbilt Ave., Brooklyn 17, N. Y.

SEPARATORS (Magnetic)

Beardsley & Piper Co., 2424 No. Cicero, Chicago 39, Ill.
Dings Magnetic Separator Co., 4740 Electric Ave., Milwaukee 7, Wis.
Homer Mfg. Co., Lima, Ohio.
National Engineering Co., 549 W. Washington St., Chicago 6, Ill.
Stearns Magnetic Mfg. Co., 662 S. 28th St., Milwaukee 4, Wis.

SHAKE-OUT MACHINERY

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.
American Air Filter Co., Louisville 8, Ky.
Bartlett & Snow, C. O., Co., 6201 Harvard Ave., Cleveland 5, O.
Beardsley & Piper Co., 2424 No. Cicero, Chicago 39, Ill.
Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.
Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.
New Haven Vibrator Co., 131 Chestnut St., New Haven 7, Conn.
Robins Conveyors, Div., Hewitt-Robins Inc., 270 Passaic Ave., Passaic, N. J.
Royer Foundry & Machine Co., Kingston, Pa.
Simplicity Engineering Co., Durand, Mich.

SHOT AND GRIT

Alloy Metal Abrasive Co., 311 W. Huron St., Ann Arbor, Mich.
American Wheelabrator & Equipment Co., Mishawaka, Ind.
American Steel Abrasives Co., Galion, O.

SHOT & GRIT (Cont'd.)

Carpenter Brothers, Inc., 606 West Wisconsin, Milwaukee 3, Wis.
Clayton Sherman Abrasives Co., 3896 Lonyo Rd., Detroit 10, Mich.
Cleveland Metal Abrasive Co., 887 E. 67th St., Cleveland, Ohio.
Hickman-Williams & Co., Union Commerce Bldg., Cleveland 14, O.
Metal Blast, Inc., 871 E. 67th St., Cleveland, Ohio.
Pangborn Corp., Hagerstown, Md.
Pittsburgh Crushed Steel Co., Pittsburgh 1, Pa.
W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2, Ohio.
Steel Shot & Grit Co., Inc., 39 Warren Ave., Boston, Mass.

SHOT (Peening)

Alloy Metal Abrasive Co., 311 W. Huron St., Ann Arbor, Mich.
American Wheelabrator & Equipment Co., Mishawaka, Ind.
American Steel Abrasive Co., Galion, O.
Cleveland Metal Abrasive Co., 887 E. 67th St., Cleveland, Ohio.
Metal Blast, Inc., 871 E. 67th St., Cleveland, Ohio.
Pangborn Corp., Hagerstown, Md.
Pittsburgh Crushed Steel Co., Pittsburgh 1, Pa.
Steel Shot & Grit Co., Inc., 39 Warren Ave., Boston, Mass.

SHOVELS

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Frederic B. Stevens, Inc., Detroit 16, Mich.

SHOVELS (Power)

Frank G. Hough Co., Libertyville, Ill.

SILICA FLOUR

Federal Foundry Supply Co., 4600 East 71st St., Cleveland 5, O.
Standard Silica Corp., 209 So. LaSalle St., Chicago 4, Ill.
Wedron Silica Co., 38 So. Dearborn St., Chicago, Ill.

SILICOMANGANESE

Electro Metallurgical Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.

SILICON (Briquets)

Electro Metallurgical Div. Union Carbide & Carbon Corp., 30 E. 42nd St., New York 17, N. Y.
Ohio Ferro-Alloys Corp., Canton 2, Ohio.

SILICON CARBIDE (Briquets)

Carborundum Co., Perth Amboy, N. J.
Electro Refractories & Abrasive Corp., Vars Bldg., Buffalo 2, N.Y.

SILVERY PIG IRON see Pig Iron (Silvery)

SKIMMERS

Tamms Industries Inc., 228 N. LaSalle St., Chicago 1, Ill.

SLIP FLASKS (See FLASKS, SLIP)

SLINGS (Chain)

Jeffrey Mfg. Co., Columbus 16, O.

SLIP JACKETS

Adams Co., Dubuque, Iowa.
Chicago Mfg. & Distributing Co., 1928 W. 46th St., Chicago 9, Ill.
Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.
Fremont Flask Co., Fremont, O.
Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.

SMELTERS & REFINERS

Christiansen Corp., 1515 No. Kilpatrick, Chicago 51, Ill.
Federated Metals Div., American Smelting and Refining Co., 120 Broadway, New York 5.
R. Lavin & Sons Inc., 3426 So. Kedzie Ave., Chicago 23, Ill.
Western Metals Co., 3201 So. Kedzie Ave., Chicago 23, Ill.

SNAGGING BELTS

Minnesota Mining & Mfg. Co., 900 Fauquier St., St. Paul 6, Minn.

SNAGGING MACHINES

Bradford Machine Tool Co., 659 Evans St., Cincinnati, Ohio.

SNAGGING WHEELS—See ABRASIVE WHEELS

SNAP FLASKS

Adams Co., Dubuque, Iowa.
Diamond Clamp & Flask Co., Richmond, Ind.
Federal Foundry Supply Co., 4600 East 71st St., Cleveland 5, Ohio.
Hines Flask Co., 3431 W. 140th St., Cleveland 11, Ohio.
V-G Flask & Fitting Co., Box 467, Madison, Conn.

SODA ASH

Federal Foundry Supply Co., 4600 East 71st St., Cleveland 5, Ohio.
Hercules Powder Co., Wilmington 99, Del.
Mathieson Chemical Corp., Mathieson Bldg., Baltimore 3, Md.
Solvay Sales Division, Allied Chemical & Dye Corp., 40 Rector St., New York 6, N. Y.

SOLDER

Federated Metals Div., American Smelting and Refining Co., 120 Broadway, New York 5.

SPACE HEATERS

Dravo Corp., Neville Island, Pittsburgh 25, Pa.

SPECIAL FOUNDRY ALLOYS

Federated Metals Division of American Smelting and Refining Co., 120 Broadway, New York 5, N. Y.
Niagara Falls Smelting & Refining Div. Continental-United Industries Co., Inc., 2204 Elmwood Ave., Buffalo 17, N. Y.
Vanadium Corp. of America, 420 Lexington Ave., New York, N. Y.

SPRAY GUNS

Murphy & Co., Jas. A., Hamilton, O.
New Haven Vibrator Co., 131 Chestnut St., New Haven 7, Conn.

SPRUE CUTTERS

Adams Co., Dubuque, Iowa.
Federal Foundry Supply Co., 4600 East 71st St., Cleveland 5, Ohio.
Freeman Supply Co., 1152 East Broadway, Toledo, Ohio.
Milwaukee Chaplet & Mfg. Co., 1023 S. 40th St., Milwaukee, Wis.
Rice Pump & Machine Co., 1026 S. 40th St., Milwaukee 15, Wis.

STEEL SHOT

American Wheelabrator & Equipment Co., Mishawaka, Ind.
Cleveland Metal Abrasive Co., 887 E. 67th St., Cleveland, Ohio.
Pangborn Corp., Hagerstown, Md.
Steel Shot Producers, Inc., Butler, Pa.

STEEL (Structural)

American Bridge Co., Pittsburgh 19, Pa.

STOPPERS (Graphite)

Joseph Dixon Crucible Co., Monmouth St., Jersey City, N. J.

STRAINER CORES

Harbison-Walker Refractories Co., 1745 Farmers Bank Bldg., Pittsburgh 22, Pa.

STRIPPING MACHINES

Adams Co., Dubuque, Iowa.
Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.
Davenport Machine & Foundry Co., Davenport, Iowa.
International Molding Machine Co., LaGrange Park, Ill.
Milwaukee Foundry Equipment Div., Spo Inc., 3238 W. Pierce St., Milwaukee 4, Wis.

TANKS (Dewatering)

Claude B. Schneible Co., 2827 25th St., Detroit 16, Mich.

TAPE (Friction & Rubber)

Boston Woven Hose & Rubber Co., 29 Hampshire, Cambridge 39, Mass.

TELLURIUM

American Smelting & Refining Co., 120 Broadway, New York 5, N.Y.

TEMPERATURE CONTROLLERS

Foxboro Company, Foxboro, Mass.
Illinois Testing Laboratories, Inc. 418 N. LaSalle St., Chicago 10, Ill.
Leeds & Northrup, 4901 Stenton Ave., Philadelphia 44, Pa.
Marshall Co., L. H., 270 W. Lane, Columbus 1, O.

TESTING EQUIPMENT

Detroit Testing Machine Co., 19390 Grinnell Ave., Detroit 13, Mich.
National Forge & Ordnance Co., Irvine, Warren Co., Pa.

TESTING MACHINES (Tensile)

Harry Dietert Co., 9330A Roselawn Ave., Detroit 4, Mich.
Detroit Testing Machine Co., 19390 Grinnell Ave., Detroit 13, Mich.
National Forge & Ordnance Co., Irvine, Warren Co., Pa.

THERMOCOUPLES

Elematic Equipment Corp., 1150 W. Marquette, Chicago 2, Ill.
Illinois Testing Laboratories, Inc., 418 N. LaSalle St., Chicago 10, Ill.
Marshall Co., L. H., 270 W. Lane, Columbus 1, O.
Pyrometer Instrument Co., Bergenfield, N. J.
Tamms Industries Inc., 228 N. LaSalle St., Chicago 1, Ill.

TIMERS (Electric)

Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.

TIN

Federated Metals Div., American Smelting and Refining Co., 120 Broadway, New York 5, N. Y.

TONGS

Industrial Equipment Co., Minster, O.

TOOLS (Pneumatic Portable)

Arrow Tools Inc., 1900 S. Kostner, Chicago, Ill.

Chicago Pneumatic Tool Co., 6 East 44th St., New York 17, N. Y.

Dayton Pneumatic Tool Co., Dayton 1, O.

Gardner-Denver Co., Quincy, Ill.

Independent Pneumatic Tool Co., Aurora, Ill.

Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.

Joy Mfg. Co., Sullivan Division, Michigan City, Ind.

Schramm Inc., West Chester, Pa.

TORCHES and BURNERS (Acetylene, Gas, Oil)

Freeman Supply Co., 1152 East Broadway, Toledo, Ohio.

Hauck Mfg. Co., 106 Tenth St., Brooklyn 15, N. Y.

Linde Air Products Co., 30 E. 42nd St., New York 17.

TOTE BOXES (see "BOXES-TOTE")

TRACTOR (Gas Powered)

Butler Bin Co. Waukesha, Wis.

Frank G. Hough Co., Libertyville, Ill.

TRADE ASSOCIATIONS

Crucible Manufacturers Association, 90 West St., New York 6, N. Y.

TRAMRAIL SYSTEMS

American MonoRail Co., 13104 Athens Ave., Cleveland 7, Ohio.

Cleveland Tramrail Div. of Cleveland Crane & Engineering Co., 1155 East 283rd St., Wickliffe, O.

Link Belt Co., 300 W. Pershing Rd., Chicago 9, Ill.

Modern Equipment Co., Port Washington, Wis.

TRAPS

Jas. A. Murphy & Co., Hamilton, Ohio.

TROLLEYS

Curtis Pneumatic Machinery Div. Curtis Mfg. Co., 1943 Kienlen Ave., St. Louis 20, Mo.

Modern Equipment Co., Port Washington, Wis.

TRUCK CRANES

Silent Hoist & Crane Co., 885 63rd St., Brooklyn 20, N. Y.

TRUCK WHEELS,

Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.

TRUCKS (Casting)

Kwik-Mix Co., Port Washington, Wis.

Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.

TRUCKS (Core)

Chicago Mfg. & Distributing Co., 1928 W. 46th St., Chicago 9, Ill.

TRUCKS (Core Oven)

Foundry Equipment Co., 1831 Columbus Rd., Cleveland 13, Ohio.

Kirk & Blum Mfg. Co., Cincinnati 9, Ohio.

TRUCKS (Power Lift)

Butler Bin Co., Waukesha, Wis.

Frank G. Hough Co., Libertyville, Ill.

Towmotor Corp., 1226 East 152nd St., Cleveland 10, Ohio.

TUBES (Annealing)

Pressed Steel Co., Wilkes-Barre, Pa.

TUBES (X-Ray)

General Electric X-Ray Corp., 4855 Electric Ave., Milwaukee 14, Wis.

TUMBLING BARRELS

Royersford Foundry & Machine Co., Royersford, Pa.

W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2, Ohio.

Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.

Whiting Corporation, 15607 Lathrop Ave., Harvey, Ill.

TURNTABLES

Beardsley & Piper Co., The, 2424 No. Cicero, Chicago 39, Ill.

Modern Equipment Co., Port Washington, Wis.

Newaygo Engineering Co., Newaygo, Mich.

Whiting Corporation, 15607 Lathrop Ave., Harvey, Ill.

UNIT HEATERS (Electric)

Dravo Corp., Neville Island, Pittsburgh 25, Pa.

VALVES (Adjustable Orifice, Air, Gas, Oil, Water, Steam)

The North American Mfg. Co., 4455 E. 71st St., Cleveland 4, Ohio.

VALVES (Air, Water, Steam)

Air-Way Pump & Equipment Co., 1050 N. Kilbourn, Chicago, Ill.

The North American Mfg. Co., 4455 E. 71st St., Cleveland 4, Ohio.

VALVES (Blow-off and Cut-off)

Champion Foundry & Machine Co., 1553 W. Madison St., Chicago 7, Ill.

Wm. H. Nichols Co., Richmond Mill, Long Island 18, N. Y.

VALVES (Oxygen, Acetylene)

Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

VENTILATING SYSTEMS

American Wheelabrator & Equipment Co., Mishawaka, Ind.

Hartzell Propeller Fan Co., Piqua, Ohio.

Joy Mfg. Co., La-Del Division, New Philadelphia, Ohio.

Kirk & Blum Mfg. Co., Cincinnati 9, Ohio.

Pangborn Corp., Hagerstown, Md.

Schneible Co., Claude B., 2827—25th St., Detroit 16, Mich.

W. W. Sly Mfg. Co., 4753 Train Ave., Cleveland 2, Ohio.

VENTS (Core Box)

Champion Foundry & Machine Co., 1314 W. 21st St., Chicago 8, Ill.

VENTS (Core Box) (Cont'd.)

Demmler & Bros., Wm. Kewanee, Ill.

C. M. Smillie & Co., 1124 Woodward Hgts. Blvd., Ferndale 20, Mich.

VIBRATORS

Adams Co., Dubuque, Iowa.

Beardsley & Piper Co., 2424 No. Cicero, Chicago 39, Ill.

Cannon Vibrator Co., 1111 Power Ave., Cleveland 14, Ohio.

Cleveland Vibrator Co., 2828 Clinton Ave., W., Cleveland 13, Ohio.

Davenport Machine & Foundry Co., Davenport, Iowa.

Federal Foundry Supply Co., 4600 E. 71st St., Cleveland 5, O.

Foundry Supplies & Mfg. Co., 2221 Orchard St., Chicago 14, Ill.

Herman Pneumatic Machine Co., Union Bank Bldg., Pittsburgh 22, Pa.

Link Belt Co., 300 W. Pershing Rd., Chicago, Ill.

Martin Engineering Co., Kewanee, Ill.

Milwaukee Foundry Equipment Co., 3238 W. Pierce St., Milwaukee, Wis.

New Haven Vibrator Co., 131 Chestnut St., New Haven 7, Conn.

Nichols Co., Wm. H., Richmond Hill, Long Island 18, N. Y.

Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, Ohio.

S P O Incorporated, 7500 Grand Division Ave., Cleveland 5, O.

Frederic B. Stevens, Inc., 18th St. & Vernor Highway, Detroit 16, Mich.

Syntron Company, Homer City, Pa.

Tabor Mfg. Co., 6225 Tacony St., Philadelphia 35, Pa.

VISES (Hydraulic, Mechanical, etc.)

Columbian Vise & Mfg. Co., 9021 Bessemer Ave., Cleveland, Ohio.

Desmond-Stephen Mfg. Co., Urbana, Ohio.

WASH ROOM EQUIPMENT

Bradley Washfountain Co., Box 732, Milwaukee 1, Wis.

WAX (Core, Vent, Pattern)

United Compound Co., Inc., 328 South Park Ave., Buffalo 4, N. Y.

WEDGES (Foundry)

Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.

WEIGHING DEVICES

Toledo Scale Co., Toledo, Ohio.

WELDING GAS

Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.

Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

WELDING APPARATUS (Electric arc)

Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.

Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

WELDING and CUTTING APPARATUS and SUPPLIES

Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.

Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

WELDING ELECTRODES (Carbon)

National Carbon Co., Carbon Products Div., 30 E. 42nd St., New York 17, N. Y.

United States Graphite Co., Saginaw, Mich.

WELDING RODS & ELECTRODES

Air Reduction Sales Co., 60 East 42nd St., New York 17, N. Y.

International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

Linde Air Products Co., 30 E. 42nd St., New York 17, N. Y.

WETTING AGENTS

Pelron Corp., 7740 West 47th St., Lyons, Illinois.

WHEELBARROWS

Sterling Wheelbarrow Co., 7100 W. Walker St., Milwaukee 14, Wis.

WHEELS, ABRASIVE (Cut-off)

Bay State Abrasive Products Co., Westboro, Mass.

Carborundum Co., Perth Amboy, N. J.

Electro Refractories & Abrasives Corp., Vars Bldg., Buffalo 2, N. Y.

Macklin Company, Jackson, Mich.

Norton Company, Worcester 6, Mass.

Raybestos-Manhattan, Inc., Manhattan Rubber Division, Passaic, N. J.

Simonds Abrasive Co., Tacony & Fraley Sts., Philadelphia 37, Pa.

Sterling Grinding Wheel Division, Cleveland Quarries Co., Tiffin, Ohio.

WHEELS (Wire Brush)

Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, Ohio.

WIRE BENDERS

Redford Iron & Equipment Co., 20733 Glendale Ave., Detroit 23, Mich.

WIRE BRUSHES

Osborn Mfg. Co., 5401 Hamilton Ave., Cleveland 14, Ohio.

WIRE CUTTERS

Federal Foundry Supply Co., 4600 East 71st St., Cleveland 5, Ohio.

Redford Iron & Equipment Co., 20733 Glendale Ave., Detroit 23, Mich.

WIRE NAILS

Republic Steel Corp., 3100 E. 45th St., Cleveland 4, Ohio.

WOODWORKING MACHINERY

Oliver Machinery Co., Grand Rapids 2, Mich.

X-RAY EQUIPMENT

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

General Electric X-Ray Corp., 4855 Electric Ave., Milwaukee 14, Wis.

X-RAY FILMS

Eastman Kodak Co., Rochester, N. Y.

General Electric X-Ray Corp., 4855 Electric Ave., Milwaukee 14, Wis.

ZINC

Federated Metals Div., American Smelting and Refining Co., 120 Broadway, New York 5, N. Y.